STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

BULLETIN NO. 20

INTERIM REPORT
CACHE CREEK INVESTIGATION

COMPARISON OF ALTERNATIVE WILSON VALLEY AND GUINDA PROJECTS ON CACHE CREEK

PRELIMINARY EDITION
SUBJECT TO REVISION

GOODWIN J. KNIGHT
Governor

HARVEY O. BANKS
Director of Water Resources

April, 1958

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STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

April 17, 1958

Yolo County Board of Supervisors
County Court House
Woodland, California

Gentlemen:

There is transmitted herewith a preliminary edition of Bulletin No. 20, Interim Report, Cache Creek Investigation, entitled "Comparison of Alternative Wilson Valley and Guinda Projects on Cache Creek", dated April, 1958. This is a report of the investigation conducted by the Department of Water Resources with funds provided by the County of Yolo and the State of California.

It is tentatively concluded that either the Wilson Valley or the Guinda Project, with a reservoir storage capacity of about 300,000 acre-feet, would be engineeringly and economically feasible. The estimated benefit-cost ratios for the Wilson Valley and Guinda Projects would be 2.6 to 1 and 2.9 to 1, respectively. In addition, extended studies and analyses indicate that a Wilson Valley Project would return maximum net benefits at a reservoir storage capacity of about 1,000,000 acre-feet, and the benefit-cost ratio would be about 3.2 to 1.

It is therefore tentatively recommended that no further consideration be given to the Guinda Project for the conservation of the waters of Cache Creek. In lieu thereof, it is recommended that the Wilson Valley Project which would return maximum net benefits be authorized, and that a feasibility investigation be initiated.

At an early date the California Water Commission and the Department of Water Resources will schedule a public meeting for the purpose of receiving the comments of interested parties.

Very truly yours,

Harvey O. Banks

HARVEY O. BANKS
Director

ACKNOWLEDGMENT

Valuable assistance and data used in this investigation were contributed by agencies of the State and Federal Governments, Yolo and Lake Counties, and by private companies and individuals. This cooperation is gratefully acknowledged.

Special mention is made of the helpful cooperation of the State Division of Highways, State Department of Fish and Game, United States Corps of Engineers, and Yolo County.

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CHAPTER I. INTRODUCTION

In March, 1955, the State Water Resources Board, in cooperation with the County of Yolo, made public an interim report of the investigations of the water resources of the Cache Creek Basin. The report presented a plan for a dual purpose flood control and water conservation reservoir at the Guinda site on Cache Creek. Following publication of the report, the Legislature requested that an investigation be made of the possibility of constructing a dam at a suitable site in the vicinity of Wilson Valley as an alternative to the development proposed at the Guinda site. In accordance with this directive, the Department of Water Resources of the State of California and the County of Yolo have cooperated in an investigation of possibilities for construction of a dam and a reservoir at the Wilson Valley site, and have compared the engineering and economic feasibility of the Wilson Valley and Guinda Projects. This report presents the results of that study.

Authorization for Investigation

The Cache Creek Investigation was commenced following an agreement entered into on May 7, 1954, between the State Water Resources Board, the County of Yolo, and the Department of Public Works, State of California. The agreement provided for (1) a review of reports of prior investigations of the water resources of the Cache Creek watershed; (2) investigations and studies to determine the present water utilization and the potential service areas for Cache Creek water in Yolo County, the water resources thereof, ultimate irrigable land, water requirements, and preliminary plans and estimates of cost for control, development, and utilization of these resources; and (3) the preparation of a report thereon.

The State Engineer, upon authorization by the Board, initiated the investigation with funds in the amount of $24,000, one-half contributed by the County of Yolo and one-half by the State of California. An interim report on the investigation was published in March, 1955, was approved by the State Water Resources Board, and transmitted to the State Legislature for its consideration.

As a result of this report, Assembly Bill No. 3598 was introduced which, when passed by the Legislature and signed by the Governor as Chapter 1950, Statutes of 1955, added Section 12663 to the Water Code. The effect of the action taken by the Legislature was to adopt and authorize the general plan of improvement for flood control and water conservation on Cache Creek, including Clear Lake, in accordance with plans and recommendations set forth in the interim report. However, the following provision was incorporated in the text of Section 12663:

> "that no funds shall be expended on planning or constructing a dam at the Guinda site below Rumsey on Cache Creek until the Wilson Valley area has been completely investigated and studied and determined by the board not to have comparable engineering and economic feasibility as compared to the Guinda site as recommended in said report."

Following passage of the legislation, representatives of the State Water Resources Board, the Division of Water Resources, and the County of Yolo met on July 15, 1955, to plan continuation of the Cache Creek Investigation. A supplemental agreement providing for further investigation, dated September 26, 1955, was formulated as a result of this meeting.

The supplemental agreement authorized the immediate initiation of further investigation activities and provided funds to meet the costs of investigation and study of the Wilson Valley area. The estimated cost of the supplemental investigation was $45,000.

Of this amount, the County of Yolo made its share, or $22,500 available to the Division of Water Resources immediately, pending the passage of the Budget Act of 1956, which provided the State's share, also $22,500, and which became available on July 1, 1956. This forward-looking action on the part of the County of Yolo advanced the investigation program by nine months over that which would otherwise have been possible. Since July, 1957, funds provided by the Budget Act of 1957, Item 263 (a) for statewide studies and investigation have been utilized to supplement the available cooperative funds.

Objective of the Investigation

The basic objective of the present study was to conduct engineering, geologic, and economic studies directed to determining the accomplishments of a project at Wilson Valley with a storage capacity equal to that of the authorized Guinda Project, and to compare the engineering and economic feasibility of the alternative projects as required by Section 12663 of the State Water Code.

In addition, studies were made to determine the size of reservoir at the Wilson Valley site which would yield the maximum net benefits when operated under present conditions of upstream development.

Scope of the Investigation

The investigation was restricted to the studies necessary to accomplish the stated objectives. Additional planning activity, with consideration given to the reservation of water for upstream use, and to the possibilities of conjunctive operation of ground water and surface storage are both desirable before a definite project proposal is formulated.

Factual data developed and presented in the interim report of March, 1955, were utilized in evaluating the Guinda Project. However, previous estimates of project costs and of benefits that would accrue therefrom were re-evaluated so as to reflect present day prices.

Additional hydrologic studies were made for the purpose of revising estimates of firm yield that could be realized from the Guinda Project, and for determining the firm yield of a reservoir at the Wilson Valley site.

Geologic exploration of dam site foundation conditions was conducted at two sites in the Wilson Valley area. In addition, construction material borrow areas were located and samples were taken for laboratory testing.

Engineering designs and estimates of cost were prepared for several sizes of reservoir storage capacity at the Wilson Valley site. Consideration was given to an upper and a lower dam site, with final selection made of an earthfill dam at the lower site.

Economic studies were made to determine the benefits that would accrue from the regulation of the waters of Cache Creek. These included agricultural economic studies to determine the amount of irrigation benefits, and a preliminary re-evaluation of flood control benefits by the United States Corps of Engineers.

Finally, detailed economic and operation studies evaluated the comparative accomplishments of the proposed Guinda and Wilson Valley Reservoirs with storage capacities of about 300,000 acre-feet. In addition, the reservoir storage capacity at the Wilson Valley site that would provide the maximum net benefits was determined.

Related Investigations and Reports

Numerous prior investigations and reports were reviewed in connection with this investigation. Of major importance are several recent investigations and reports of the Department of Water Resources and of its predecessor, the Division of Water Resources. Following is a brief summary of these investigations.

The California Legislature, in recognition of the growing statewide water problem, directed the State Water Resources Board, by Chapter 1541, Statutes of 1947, to conduct an investigation of the water resources of California. This study was designated the "State-wide Water Resources Investigation". Funds were provided in the 1947-48 budget for commencement of the investigation and additional funds were provided, through 1955, by subsequent legislative appropriations.

The State-wide Water Resources Investigation was conducted under direction of the State Water Resources Board by the Division of Water Resources of the Department of Public Works. Three bulletins were published containing the results of this investigation. Bulletin No. 1, "Water Resources of California", published in 1951, contains a compilation of data on precipitation, unimpaired stream runoff, flood flows and frequencies, and quality of water throughout the State. Bulletin No. 2, "Water Utilization and Requirements of California", published in June, 1955, includes determinations of the present use of water throughout the State for all consumptive purposes and presents forecasts of probable ultimate water requirements, based in general in the capabilities of the land to support further development. The third, and concluding, phase of the State-wide Water Resources Investigation was reported in Bulletin No. 3,

entitled "The California Water Plan", published in May, 1957. This bulletin presents preliminary plans for the full practicable development of the water resources of the State to meet the ultimate water needs therein, insofar as possible.

Information pertaining to the Cache Creek Basin that was assembled for these reports was reviewed and utilized for the purposes of this investigation.

As previously stated, an interim report on development of the water resources of Cache Creek, entitled "Cache Creek Investigation" was published in March, 1955. The investigation reported upon comprised studies of the flood control problems of the rim lands around Clear Lake in Lake County and of means for alleviation of these problems, and studies of problems connected with flood control and water supply in Yolo County and of means for conserving the presently wasted waters of Cache Creek. Detailed engineering and geologic studies were made for a dam and reservoir on Cache Creek above the town of Guinda in the upper end of Capay Valley. Much of the basic data presented in the interim report was used in the comparison of the Wilson Valley and Guinda Projects.

The Northeastern Counties Investigation, a detailed study of land and water uses and needs covering the major portion of the Sacramento Valley and adjacent areas, also developed data which were used in the Cache Creek Investigation. A preliminary edition of the report of this investigation, entitled "Northeastern Counties Investigation", Bulletin No. 58 of the Department of Water Resources, was completed in April, 1958, and is presently in process of publication.

The Legislature, by Chapter 1748, Statutes of 1951, directed the Department of Public Works, acting through the State Engineer, to:

". . . make an investigation of, and report upon the surface and underground water supplies of the Putah Creek Cone and areas adjacent thereto, in the Counties of Solano and Yolo, including but not limited to the present utilization of water, future water requirements, possible sources of supplemental water supplies which may be necessary to meet the present and ultimate requirements therefor, and the Department may incorporate findings in such report as to the feasible methods of solving the problems involved."

The report, entitled "Putah Creek Cone Investigation", incorporating the results of this study, was published in December, 1955. The area investigated included that which lies between Cache and Putah Creeks. Since this area would probably constitute a portion of the service area provided for by a project constructed on Cache Creek, the studies conducted for that investigation are pertinent to, and were used in, the studies and analyses accomplished in the Cache Creek Investigation.

An extensive bibliography of additional reports containing data pertinent to the development of the water resources of Cache Creek is to be found in the interim report of March, 1955.

Area of Investigation

Wilson Valley and Capay Valley, within which lie the alternative reservoir sites discussed in this report, are located in the southeast and northwest extremities of Lake and Yolo Counties, respectively. The principal source of water supply available for regulation at these reservoir sites originates in the watershed of the North Fork of Cache Creek. In addition, substantial quantities of the overflow that periodically spills from Clear Lake could be regulated by either reservoir. Guinda Reservoir also would regulate the flow of Bear Creek, which enters Cache Creek downstream from the Wilson Valley site.

Clear Lake is a shallow natural lake situated approximately 110 miles north of San Francisco and 110 miles northwest of Sacramento at an elevation of about 1,300 feet. The drainage area tributary to the lake contains about 460 square miles, is generally mountainous in character, and includes several large valleys suitable for diversified agricultural practices. Along the shore line of Clear Lake are found extensive recreational facilities provided to service the boating, swimming, and fishing activities made possible by the existence of the lake. The communities of Lakeport, Upper Lake, and Kelseyville are the major urban developments.

Downstream from the outlet of Clear Lake, Cache Creek descends through a rugged canyon to its confluence with the North Fork, near the upper end of Wilson Valley. From this point, Cache Creek flows some 2.5 miles through Wilson Valley and thence about 18 miles through a canyon into Capay Valley. The entire area downstream from Clear Lake and above Capay Valley, including the North Fork basin, is a sparsely settled mountainous area interspersed with a few valleys wherein limited livestock grazing is provided by indigenous areas of open range.

The appropriate service area for either the Wilson Valley or Guinda Project lies downstream from the reservoir sites and is divided into an upper and a lower area. The upper area consists of Capay Valley, while the lower area is that portion of the western Sacramento Valley on the Cache Creek alluvial fan in Yolo County.

Capay Valley commences at the mouth of Cache Creek Canyon and extends for approximately 16 miles in a southeasterly direction to the western edge of the Sacramento Valley. The floor of Capay Valley varies from about 1 to 3 miles in width. Agriculture,

including the production of alfalfa, deciduous fruits, nuts, and grain, provides the major source of income. Water applied to irrigated crops is obtained from diversions from Cache Creek, supplemented by pumping from ground water sources. The dry farming that is practiced depends upon rainfall, which approximates 26 inches in depth annually. Flood damages occur below Rumsey, at the upper end of the valley, during periods of high water when the runoff exceeds the channel capacity of Cache Creek. Limited development has centered in the communities of Rumsey, Guinda, and Capay.

The principal area which would derive benefits from the development of Cache Creek lies on the Sacramento Valley floor. The economic development of this area is based almost entirely on agriculture. Formerly, the major portion of its tillable land was devoted to the production of grains grown under dry farming methods. The development of irrigation has been accompanied by a greater diversification of crops and an increase in production. Principal irrigated crops include alfalfa, rice, peaches, apricots, almonds, sugar beets, and tomatoes. Irrigated permanent pasture provides feed for beef, dairy cattle, and sheep.

Distribution works for delivering the waters of Cache Creek to parts of the valley service area have been developed by local enterprise. A canal system, including the Capay and Adams Canals, originates at the Capay diversion dam and conveys water along the west, south, and north edges of the lower Cache Creek Basin. Moore Dam, located on Cache Creek approximately 10 miles downstream from Capay Dam, diverts water into the Moore Canal System for distribution to lands lying west of Woodland. These systems are owned and operated by the Clear Lake Water Company. The available water supply is made

up of controlled releases and spill from Clear Lake, together with unregulated flow tributary to Cache Creek occurring downstream from the outlet of the lake.

Local industry in the Cache Creek Service Area is supported largely by agricultural production. Various plants process meat, dehydrate vegetables and fruit, and refine sugar beets. In addition, packing houses and cold storage plants serve the food processing industry. The expansion of highways and railroad facilities has kept pace with the agricultural and industrial development of the area. The cities of Woodland, Davis, and Winters are the major centers of urban development.

The climate of the Cache Creek Basin is characterized by a mild two-seasonal pattern. Approximately 90 per cent of the average seasonal rainfall occurs in the months from November through April. Mean seasonal rainfall varies from less than 16 inches in the vicinity of Davis, to over 50 inches in the highlands on the western edge of the Cache Creek Basin. Winter temperatures seldom fall below freezing, and temperatures of the warm, dry summers frequently exceed 100° Fahrenheit. The average frost-free period in the valley area is about 250 days.

Runoff from the Cache Creek Basin is derived principally from precipitation falling as rain. Snowfall occurs rarely and is of little significance as a source of runoff. The majority of the runoff occurs immediately following the rainfall but is prolonged somewhat by accretions to the streams from retained soil moisture. However, stream flow diminishes to negligible amounts during the summer and fall. There are springs that maintain a limited flow through the summer, although many contain water of poor quality. The resulting seasonal runoff pattern is one of concentrated winter and early spring floods, and meager summer flows, some of which are of poor quality.

In addition to the intraseasonal fluctuations, runoff varies from season to season depending upon the amount of seasonal precipitation. Therefore, in order to develop a firm water supply for the Cache Creek Service Area, it is necessary to provide sufficient storage capacity to facilitate the carry-over of water supplies from years of high precipitation for use in years of low precipitation.

CHAPTER II. ENGINEERING AND ECONOMIC CONSIDERATIONS

This chapter discusses the criteria, methods of analysis, and basic procedures used in planning and comparing the proposed Wilson Valley and authorized Guinda Projects. The various aspects are considered and discussed under the general headings "Engineering Considerations" and "Economic Considerations". The features and estimated accomplishments of the alternative reservoir sites are described in Chapter III, and an engineering and economic comparison is presented in Chapter IV.

Engineering Considerations

A water conservation project may be considered to have engineering feasibility if (1) the water supply is adequate in quantity and quality; (2) sites for the dam, reservoir, and other facilities are geologically suitable; (3) it can be built with the available materials and techniques and at a reasonable cost; (4) the proposed structures are properly designed and functionally sufficient.

In the ensuing discussion the procedures that were used to determine the engineering feasibility of the proposed Wilson Valley and Guinda Projects are described.

Terms used in this discussion are defined as follows:

Annual — The 12-month period from January 1 of a given year through December 31 of the same year, sometimes termed the calendar year.

Seasonal — Any 12-month period other than the calencar year.

Mean Period — A period chosen to represent conditions of water supply and climate existing during a long period of years. As it relates to runoff it is the 53-year period from 1894-95 to 1946-47.

Average Period	A period chosen during which the conditions of water supply and climate represent the mean period and during which reliable records are available. For purposes of this report the average period was chosen to be the 45-year average period 1911-12 to 1955-56. Average runoff during this period is about 80 per cent of the mean runoff.
Mean	The arithmetical average of quantities occurring during the mean period.
Average	The arithmetical average of quantities occurring during other than mean periods.
Firm Yield	The maximum sustained rate of draft from a reservoir that could be maintained through a critically deficient water supply period to meet a given demand for water. For purposes of this report, firm yield was assumed acceptable with an average deficiency of 2 per cent per year and a maximum deficiency of 50 per cent during one year of the base period.

Water Supply

The major portion of the water supply available for regulation in a reservoir on the main stem of Cache Creek originates as rainfall in the Upper Clear Lake-Cache Creek Basin. Runoff from snowfall is of limited importance in the basin. Since runoff is largely from rainfall, it is closely allied with the duration and intensity of storms during the winter period. The seasonal runoff pattern is varied, with large flows occurring in the winter and early spring, meager flows occurring in the summer and fall, and both supplemented by limited flow from perennial springs. In addition to variations within the season, runoff fluctuates widely from season to season. For example, seasonal runoff in 1930-31 was about 10 per cent of the average for the period of record, while in 1940-41 it was about 290 per cent of the average.

Under the present method of operation, runoff from the Clear Lake Basin is partially regulated by Clear Lake Impounding Dam, located on Cache Creek about 5 miles below the natural outlet of Clear Lake. The Grigsby Riffle, a natural restriction in the channel about 2 miles below the natural lake outlet, limits, under certain conditions, the regulating effect of the dam. The water surface of the lake is controlled, within these physical limitations, as required by the Gopcevic and Bemmerly Decrees. Copies of these decrees will be found in Appendix D of this report.

Natural flows and releases from Clear Lake for irrigation use flow unimpaired down Cache Creek to the first point of diversion in upper Capay Valley. In addition to flows from the Clear Lake Basin, the water supply is augmented by the flow of several tributary streams, principally the North Fork of Cache Creek and Bear Creek.

The seasonal water supplies available for regulation in Wilson Valley and Guinda Reservoirs were determined for the 45-year average period, 1911-12 to 1955-56. The seasonal quantity of water available for regulation by Wilson Valley Reservoir comprises water released and wasted from Clear Lake, runoff of the North Fork of Cache Creek, and runoff from the remaining tributary area below Clear Lake. This quantity was based on measured and estimated natural flows, and a theoretical operation of Clear Lake.

Monthly stream flow for the North Fork of Cache Creek near Lower Lake, for the period prior to 1931, was estimated by direct correlation with stream flow records of Putah Creek near Winters. The historical record flow was used for the years following 1931.

The estimated seasonal runoff to the Wilson Valley Reservoir from the drainage areas below the Cache Creek gaging station

near Lower Lake, and from the drainage area below the North Fork gaging station near Lower Lake, was computed from a multiple correlation between average annual precipitation and annual flows at seven stations in and adjacent to the Cache Creek Basin. These seasonal estimates were reduced to monthly runoff estimates by proportion with the recorded and estimated monthly runoff of the North Fork of Cache Creek at the gaging station near Lower Lake.

In order to determine the releases available for downstream irrigation use without further regulation and the quantity of water wasted from Clear Lake during the mean period, with present (1953) conditions of impairment, a theoretical operation study was made of Clear Lake. The first step in this study was to estimate the presently impaired inflow into the lake. This was accomplished by utilizing historical data relating to evaporation, change in storage, releases, spills, and combining these data with the present (1953) use of water. Secondly, operation studies of Clear Lake were made, using the water supply data determined as above, and imposing the stipulations of the Gopcevic Decree. Releases for irrigation use in Yolo County were based on a monthly demand schedule derived from an average of the recorded diversions for the last 15 years. The maximum monthly diversions did not exceed 38,000 acre-feet, and maximum seasonal diversion did not exceed 160,000 acre-feet. A summary of the operation studies for Clear Lake and various sizes of reservoirs at Wilson Valley are presented in Appendix A, "Reservoir Yield Studies".

As the result of the operation studies, the average seasonal quantity of water available for storage at the Wilson Valley Reservoir for the average period, 1911-12 to 1955-56, was estimated to be about 276,000 acre-feet, including about 116,000 acre-feet of

water spilled from Clear Lake. In addition, an average seasonal irrigation release of 95,500 acre-feet would be made from Clear Lake and would pass through Wilson Valley Reservoir. The estimates of seasonal inflow to Wilson Valley Reservoir, segregated into (1) runoff of the tributary area of Cache Creek below Clear Lake Dam including the North Fork of Cache Creek, (2) spill from Clear Lake, and (3) irrigation release from Clear Lake, are presented in Appendix A.

For comparative purposes, operational studies were made of Guinda Reservoir using water supply data similar to those established to evaluate the reservoir at Wilson Valley. The water supply available for regulation in Guinda Reservoir consists of that computed as available to Wilson Valley Reservoir, plus the flow of Bear Creek at the Bear Creek gaging station near Rumsey, and the runoff from the intermediate area between Wilson Valley Dam, the Bear Creek gaging station, and Guinda dam site.

The runoff record of the station on Bear Creek was extended by correlation with the station on the North Fork of Cache Creek near Lower Lake to obtain a runoff record for the base period. The runoff from the intermediate area was estimated by a multiple correlation similar to that used for the area immediately above Wilson Valley dam site.

These studies indicated the average seasonal quantity of water available for storage at Guinda Reservoir for the average period, 1911-12 to 1955-56, would be approximately 359,000 acre-feet, including about 116,000 acre-feet of water spilled from Clear Lake. In addition, an estimated average seasonal irrigation release of 95,500 acre-feet would be made from Clear Lake to pass through Guinda Reservoir.

It was assumed that sedimentation in either of the reservoirs would cause no appreciable loss in storage during the period used for economic analysis of the project. Geologic and ground cover conditions in the basin above the reservoir retard the erosion of large quantities of silt into the stream.

Water Quality. The mineral quality of surface waters of the Clear Lake-Cache Creek Basin was studied during the initial phase of the Cache Creek Investigation. Data were obtained from samples collected periodically from Cache Creek at Capay Dam during the period from 1933 to 1939. The conclusions presented herein utilize these data as well as data from more recent samples.

Suitability of water for irrigation use is determined in accordance with the following criteria:

The minerals recognized as the principal criteria for quality classifications are: (1) total dissolved mineral solids; (2) chloride concentration; (3) percentage of sodium; and (4) boron concentration. Irrigation waters are divided into three broad groups as:

Class I	Excellent to good, or suitable under most conditions
Class II	Good to injurious, or harmful to some plants under certain conditions
Class III	Injurious to unsatisfactory, or harmful to most plants under most conditions

These limits are presented in Table 1.

TABLE 1

QUALITATIVE CLASSIFICATION OF IRRIGATION WATERS

Chemical properties	Class I Excellent to good	Class II Good to injurious	Class III Injurious to unsatisfactory
Total dissolved solids:			
In ppm	Less than 700	700 - 2,000	More than 2,000
In conductance EC x 10^6 at 25° C	Less than 1,000	1,000 - 3,000	More than 3,000
Chloride, in ppm	Less than 175	175 - 350	More than 350
Sodium, in per cent of base constituents	Less than 60	60 - 70	More than 70
Boron, in ppm	Less than 0.5	0.5 - 2.0	More than 2.0

Class II irrigation water is of doubtful suitability, under certain conditions, for low-salt-tolerant crop plants, including citrus and deciduous fruit, several vegetables, and most clover grasses. Class III water is ordinarily unsatisfactory for all crops except the more tolerant plants such as cotton, beets, and salt-tolerant forage grasses.

These criteria have been found to be limitations in actual practices. In many instances a water may be wholly unsuitable for irrigation under certain conditions of use and yet be completely satisfactory under other circumstances. Soil permeability, temperature, humidity, rainfall, and other contributing conditions must be considered in addition to quality classification of a water for irrigation use.

Water released through Clear Lake Dam is moderately hard, due to its predominant mineral content of calcium bicarbonate. Its high concentration of boron, ranging from 0.74 to 1.4 parts per million, lowers the quality classification from Class I to Class II.

Below the confluence of the main stream and the North Fork of the stream, the water is classed as "very hard" because of the high content of the bicarbonates of sodium and calcium. In addition, it contains concentrations of boron varying from 0.3 to 7.2 parts per million. However, in either of the reservoirs under consideration, the mixing of the slightly better water of Cache Creek with that of the North Fork would probably result in a more uniform, moderately hard water. Also, in either reservoir, the boron content, the major degradant to Cache Creek water, would be reduced in concentration as the result of storing and mixing the better quality waters occurring during high flows with the poorer waters of low flows.

Bear Creek, with its many mineralized springs, is a major contributor of degradants. Mineralized waters originating on the west slope of Capay Valley add to the degradation of the water supply. However, with the construction of the Guinda or Wilson Valley Project, the water containing these degradants would be improved by mixing with the better water of Cache Creek.

It has been concluded, therefore, that the boron concentration of the regulated water at Capay Dam under operation of either Wilson Valley or Guinda Reservoir would probably average between 1.0 and 1.5 parts per million. The water in either instance would be a calcium carbonate type and would be classified as "good" for general beneficial uses.

Flood Hydrology

The estimate of the peak flood inflow into Wilson Valley Reservoir was developed from a regional study of flood frequencies and unit hydrographs. The once-in-1,000-year flood was selected for

use as the spillway design flood. This flood hydrograph was developed by routing a theoretical once-in-1,000-year flood through Clear Lake and superimposing thereon a second hydrograph based upon known hydrologic conditions in the region comprising the remainder of the drainage area above Wilson Valley dam site.

The characteristics of an estimated once-in-1,000-year flood in Kelsey Creek near Kelseyville were used as the basis for the flood flow estimates for the Clear Lake Basin. The flood developed by this procedure was then routed to Wilson Valley Reservoir through an assumed enlarged outlet channel from Clear Lake into Cache Creek. The enlarged channel would have a capacity of 8,500 second-feet when the water level at the Rumsey gage was 7.56 feet.

It is estimated the flood resulting from these operations, when combined with the maximum runoff of the tributary drainage area of Cache Creek above Wilson Valley reservoir site, would yield a peak inflow to the reservoir of 84,000 second-feet.

Prior to 1958, the maximum flood recorded at the United States Geological Survey stream gaging station "Cache Creek near Capay" occurred January 21, 1943, and amounted to 27,500 second-feet. The estimated flood peak at this station on February 24, 1958, subject to later verification, was 52,000 second-feet.

Surveys and Maps

Topographic maps of the reservoir area and dam sites in Wilson Valley were obtained from the United States Bureau of Reclamation. The maps were prepared at a scale of 1 inch equals 400 feet, with a contour interval of 20 feet. Topographic maps of the Guinda reservoir area at a scale of 1 inch equals 400 feet with a contour

interval of 20 feet were obtained by the Division of Water Resources in 1954. Other maps used in the investigation were United States Geological Survey quadrangles, at a scale of 1:62,500 with a contour interval of 50 feet.

Geologic Exploration

Preliminary geologic explorations were conducted to investigate the foundation conditions at the Wilson Valley and Guinda dam sites. The Wilson Valley site was explored during 1955 and 1956, under the present phase of the Cache Creek Investigation, and Guinda dam site was explored in 1953.

The objective of the geologic explorations was the selection, from a design and construction standpoint, of the most desirable site, and the procurement of data to assist in the design of the dam and appurtenant structures. The exploration programs consisted of surface inspection and geologic mapping of the dam and reservoir sites; test drilling along the axes of the proposed dams and in the abutments and spillway areas; the collection of soil samples to determine the construction properties of available materials; and the determination of quantities of available construction materials. In studying the dam sites, particular attention was given to determination of the rock types, degree of weathering, patterns of jointing, and the nature and extent of shear zones. These factors influence the required designs and indicate probability of leakage through the foundation of the dam. Depths of stripping necessary to expose suitable foundation for earthfill dams were determined from the drilling programs. Detailed reports of these investigations are included in Appendix C.

Two possible dam sites were explored at Wilson Valley, an upper and lower site. The upper site is at a constriction in the canyon of Cache Creek immediately below Wilson Valley. The lower site is about 1 mile farther downstream. Locations of these sites are shown on Plate C1 of Appendix C.

The geologic exploration in Wilson Valley resulted in the conclusion that the lower site was better suited to the construction of an earthfill dam to the required height. Factors leading to this conclusion were the more favorable topographic conditions, a lesser amount of fracturing and faulting of the foundation and abutment rocks, and better foundation conditions resulting in a lessened possibility of leakage. Other considerations were the reduced quantity of stripping necessary to expose suitable foundation conditions in the channel and abutment sections, and a lesser requirement for blanketing and lining the spillway due to the greater impermeability and stability of the underlying material.

The geologic exploration at the Guinda dam site, located just north of the town of Guinda, included surface inspection and test drilling. This site is in an alluvium-filled valley, in contrast to the rocky canyon at the Wilson Valley site. A seismic survey along the axis of the dam and a detailed exploration of Capay Valley in the vicinity of the reservoir site were made. The site was found to be suitable, although extensive excavation may be necessary in order to provide a suitable cutoff to prevent leakage. At the site selected, an adequate spillway location could be located through an existing saddle behind the left abutment.

Appraisal of Reservoir Lands

Preliminary estimates were made of the value of lands, improvements, and public utilities within the alternative reservoirs under consideration. An appraisal made of the Guinda reservoir site in January, 1955, was re-evaluated on the basis of current economic conditions during the present phase of the investigation. In addition, a new survey was made of Wilson Valley dam and reservoir site in February, 1957.

Real estate was evaluated by the market analysis method in which each tract of land is appraised by comparison with recent transactions in which similar properties were involved. Data on land ownership, and descriptions of properties, were obtained from the County Assessor, and data on recent sales and costs of properties, in and adjacent to the areas, were obtained from the County Recorder and from local real estate agencies. Estimates of the value of improvements and public utilities were made separately, based upon replacement costs. Improvements include buildings, structures, private water systems, and private irrigation works. Public utilities include highways, roads, telephone and electric power lines, municipal water works, and irrigation service agency works. Replacement costs were estimated as the expenditure required under existing conditions to replace a structure with a similar one of comparable utility.

For purposes of this report it was assumed that the market value of land and property would represent the present worth of the future productivity of lands flooded by reservoir development.

Estimates were also made of damage that might accrue to a property owner because of adverse effects of a public works project, including severance of property; reduction of area of

operation; loss of, or obstructions to, communications; loss of arable lands by reason of flooding; and other elements.

All developed lands, as well as the accessible portions of the undeveloped lands within the reservoir areas, were inspected and evaluated in the field. Cost estimates of proposed highway relocations were made in cooperation with the State Division of Highways.

Design and Cost of Structures

Engineering designs were made of several sizes and types of earthfill dams at the lower Wilson Valley site, primarily to determine the capital and annual costs of the required structures. Data discussed previously in this chapter were used as the basis for these designs and cost estimates. Features selected for construction may be modified with future design studies, but are considered adequate to provide reliable cost estimates. The estimates of cost are considered adequate for the purpose of comparing the engineering and economic feasibility of alternative proposed projects. Designs and estimates of cost for the Guinda Project were made during the initial phase of the Cache Creek Investigation. No revisions of this work have been made other than to modify the costs of the Guinda Project to reflect present-day prices.

Structures were designed in accordance with standard engineering principles, with the objective of obtaining the most economical combination of dam embankment, spillway, and outlet works. The dams were designed to be constructed of available natural materials, with adequate consideration being given to foundation conditions. Stability characteristics of the embankments were based on laboratory

tests of sampled materials. Spillways were sized to pass the design flood, using surcharge storage above the spillway crest to reduce the peak outflow.

Estimates of capital cost for each project include construction costs of the dam and appurtenances, acquisition of reservoir and dam sites, and relocation of public utilities. Capital costs are based on unit prices prevailing as of the fall of 1957. Also included are allowances of 10 per cent of the total cost for engineering and administration and 15 per cent of the total cost for contingencies in construction. Interest during construction was added to the capital cost in the amount of 4 per cent per annum for one half of the construction period.

Annual costs include interest on the capital investment at 4 per cent per annum, amortization of a 50-year period on a 4 per cent sinking fund basis, and the annual outlay required for replacement, operation and maintenance, and general expense.

It is believed that the features of the projects as presented herein reasonably represent those which would be selected for construction to meet the stated accomplishments. Changes in design would probably be made after further exploration of the sites and more thorough design analysis. However, the costs estimated for the Wilson Valley Project are adequate for comparison with the previous estimates for the Guinda Project, and for the purpose of evaluation of engineering and economic feasibility.

Economic Considerations

Economic studies were made to determine the benefits that would accrue from a reservoir at the Wilson Valley site, as well as

from a reservoir at the Guinda site. These benefits were used in comparing the economic accomplishments of the two alternative projects. The principal benefits realized from either project would be those resulting from an increase in agricultural income. Studies to determine irrigation benefits included detailed analyses of the possible service area to determine the extent of presently irrigated lands, probable crop pattern under project conditions, estimates of water requirements, and net farm income that would accrue to the service area under various project conditions.

Other factors of importance in evaluating and comparing the projects are the benefits that would accrue from flood control protection and from recreation made available as a result of the reservoir development. A preliminary estimate of flood control benefits was obtained from the United States Corps of Engineers. Recreation benefits, including a study of the enhancement of the stream for fish and wildlife purposes, that would be realized with project development were investigated but not evaluated in monetary terms.

The following terms are used as defined in connection with the ensuing discussion:

Consumptive Use of Water. Water consumed by vegetative grown in transpiration and building of plant tissue, and water evaporated from adjacent soil, from water surfaces, and from foliage. Also water similarly consumed and evaporated by urban and nonvegetative types of land use.

Farm Irrigation Efficiency. The ratio of consumptive use of applied irrigation water to the total amount of water delivered to the farm, commonly expressed as a percentage.

Farm Delivery. The amount of water delivered at the farm head gate to provide for all beneficial uses, and for irrecoverable losses incidental to such uses.

Benefits. The identifiable increases or gains in assets or values resulting from a project, either as tangible goods or services or as intangibles, either primary or secondary, which take account of conditions "without" and "with" the project. Only primary benefits are considered in the evaluation of projects in this report.

Primary Benefits. The identifiable net values of the goods or services resulting directly from the project, obtained by deducting from the gross benefits all costs of realization except the economic costs of the project. Examples of primary benefits are the net savings in transportation costs, the flood or other damages prevented, the net value of power produced, etc.

Economic Feasibility. This term, used in the authorizing legislation, was construed to refer to the determination of the relationship between costs incurred in, and the benefits which are derived from, the construction and operation of a water development project. It is expressed as an arithmetic proportion of estimated average annual benefits to average annual costs, and termed "benefit-cost ratio".

Net Farm Income. The residual amount of gross receipts less cost of production, excluding water cost and management charges.

Repayment Period. The period of time, commencing with the year a facility or project becomes operational or at the end of an allowable development period, during which all reimbursable costs as well as annual operation, maintenance, and replacement costs will be paid by project beneficiaries. For this study the period of time is considered to be 50 years.

In making the analysis of economic feasibility only tangible primary benefits were used. In the final selection of a project, consideration should also be given to secondary and intangible benefits.

The optimum size of the Wilson Valley Project was considered to be that at which the incremental benefit just equaled the incremental cost, as determined by consideration of costs and of flood control and irrigation benefits. A project of this size would yield maximum net benefits from the available water supply.

The benefits of the proposed projects accrue primarily from new irrigation supplies, flood control, and recreational opportunities, and these factors will be discussed in the following sections.

Irrigation Benefits

By means of irrigation it is possible to cultivate a wide variety of crops in the Cache Creek Service Area and to obtain

a much greater crop yield than is possible with dry-farming operations. Present irrigation development in this area reflects maximum use of the partially regulated available surface water supply which is supplemented by ground water pumping. Project development would provide a basis for increased agricultural productivity and income in the service area by making new firm water supplies available to replace the present unregulated and fluctuating seasonal flows. In addition to primary irrigation benefits, secondary benefits would result from the associated stimulus to the local economy.

Project Area. The Cache Creek Service Area, provided for by either the Guinda or Wilson Valley Projects, consists of lands within the lower Clear Lake-Cache Creek Basin in Yolo County. The general area, delineated on Plate 2, is bounded on the north by the Colusa Trough Drainage Canal, on the east by the Yolo Bypass, on the south by Putah Creek, and on the west by the easterly slopes of the Coast Range. Water could not be provided from the projects under consideration for all irrigable lands within this general area. For the purpose of economic analysis, it was necessary to limit the extent of the service area to those lands which could be served from the water supply made available from each alternative project. Such portions of the service area are titled "Project Area" and are given only in terms of area and not delineated.

Data on the extent of irrigable and presently irrigated lands, as compiled for the "Interim Report, Cache Creek Investigation", were used in this study. Present land use was based on land use surveys made by the Division of Water Resources during 1952, 1953, and 1954. At that time it was estimated that there were about 120,000 acres under irrigation in the service area.

The irrigable lands shown in the interim report were determined from a land classification survey conducted by the United States Bureau of Reclamation in 1944, with minor modifications by the Division of Water Resources. A total of 264,000 acres was classified as irrigable. After subtracting lands irrigated by ground water, lands within the Yolo-Zamora Water District, urban lands, and fallow lands used in rotation with lands irrigated by ground water, it was estimated that a gross area of 158,700 acres could be considered as a possible service area for the waters of Cache Creek. This area includes lands presently utilizing water diverted from Cache Creek. A breakdown of the land areas comprising the total irrigable land in the Cache Creek Service Area is shown in Table 2.

TABLE 2

CLASSIFICATION OF IRRIGABLE LANDS IN CACHE CREEK SERVICE AREA, BASED UPON SOURCE OF WATER SUPPLY AND MAJOR CLASSES OF USE

Classification	Area, in acres	
Total irrigable land in Cache Creek Service Area		263,900
Lands from which benefits were not considered		
Land irrigated from ground water supply	63,200	
Irrigable land in Yolo-Zamora Water District	19,000	
Fallow land used in rotation with lands irrigated from ground water supplies	11,000	
Urban lands	12,000	
Subtotal		105,200
Possible project area for either the Wilson Valley or Guinda Project		158,700

Crop Pattern. The crop patterns in the service area that would be irrigated under the projects considered herein were based upon the present crop pattern, upon data presented in the publication of the United States Department of Agriculture, Bureau of Soils, "Soil Survey of the Woodland Area, California", and upon all available recent information relating to the adaptability of crops to the soil conditions and climatic characteristics of the area. Such factors as crop rotation requirements, acreage limitations of crops, and water costs were also considered.

Water Requirements. The quantity of water required for use by irrigated crops was estimated from unit values of consumptive use of applied water and appropriate farm irrigation efficiency factors. Conveyance losses were added to this value to determine the water requirement at the point of diversion.

Unit values of consumptive use of applied water were estimated from direct measurements of consumptive use for crops grown on the University of California farm at Davis, and from correlations of these data with climatological factors. Much of the data relating to estimates of demand for irrigation water, as well as water requirements for uses other than irrigated crops, was based on information compiled for the statewide water resources investigation, the results of which were published by the State Water Resources Board in Bulletin No. 2, "Water Utilization and Requirements of California". Unit values of consumptive use of applied water, farm irrigation efficiency, and farm delivery for crops in the Cache Creek Service Area are presented in Table 3.

TABLE 3

ESTIMATED UNIT VALUES OF WATER REQUIREMENTS
FOR PRINCIPAL CROPS IN CACHE CREEK SERVICE AREA

Crops	Consumptive use of applied water, in feet of depth	Farm irrigation efficiency, in per cent	Farm delivery, in feet of depth
Fruits and nuts			
Almonds	1.5	75	2.0
Apricots	2.0	75	2.7
Prunes	2.0	75	2.7
Walnuts, peaches	2.5	75	3.3
Field and truck			
Alfalfa	2.7	75	3.5
Irrigated pasture	3.0	70	4.3
Sugar beets	1.8	75	2.4
Tomatoes	2.0	75	2.7
Beans, Milo, etc.	1.5	75	2.1
Melons and other truck	1.5	70	2.1
Rice	4.1	75	9.0

Crop Yields. Crop yields for both irrigated and dry-farmed crops were assumed to be in the range of "usual" to "good". Data were based upon reports of the Yolo County Agricultural Commissioner and upon the experience of local farmers. Typical yields used for determination of benefits are shown in Table 4.

Farm Prices. Average prices received by farmers at the first point of delivery during the 10-year period, 1946 through 1955, as reported in the Yolo County Agricultural Commissioner's Annual Reports, were assumed to prevail during the period of economic analysis.

Crop Production Costs. Crop production costs were derived from labor and material requirements reported in California Agricultural Extension Service crop-enterprise studies, to which were

applied average unit costs during the 10-year period of 1946 through 1955. Production costs per acre for generally accepted economic size farm operations under average management abilities were computed. The costs include hired and operator's labor, use of farm machinery and equipment, materials used in production, interest on investment, depreciation, taxes, insurance, and miscellaneous charges; they exclude cost of project water and management charges.

Hourly farm wages of $0.85 and $1.00 for unskilled and skilled labor, respectively, were used. Tax costs were computed at the current rate utilized in Yolo County. Interest costs on farm investment were assumed to be 5 per cent of inventory value.

Net Farm Income. Net farm income was considered to be the residual of gross receipts from farm production less the cost of production, excluding water cost and management charges. The net farm income on a per acre basis for the principal crops in the service area is presented in Table 4.

Computation of Irrigation Benefits. Net farm income from the service area was computed for an irrigable area of 158,700 acres for (1) preproject, or existing, conditions assuming an average diversion of 105,000 acre-feet seasonally at Capay and Moore Dams, (2) a 300,000 acre-foot storage capacity reservoir at Wilson Valley and an average diversion of 142,000 acre-feet seasonally at Capay and Moore Dams, (3) a 1,000,000 acre-foot storage capacity reservoir at Wilson Valley and an average diversion of 252,000 acre-feet seasonally at Capay and Moore Dams, and (4) a 303,000 acre-foot storage capacity reservoir at Guinda and an average diversion of 158,000 acre-feet seasonally at Capay and Moore Dams.

TABLE 4

ESTIMATED ANNUAL NET FARM INCOME DURING THE PERIOD OF ECONOMIC ANALYSIS FOR PRINCIPAL CROPS IN PROJECT AREA

Crops	Yield, per acre	Unit	Price per unit, in dollars	Monetary values per acre, in dollars		
				Gross income	Farm expenses	Net farm income
Irrigated						
Almonds	1,500	lbs.	0.27[b]	405	227	178
Apricots	5.0	ton	127.00	635	450	185
Prunes	1.9	ton	200.00	380	270	110
Walnut	1,600	lbs.	0.24[b]	384	210	174
Peaches, Freestone	8.5	ton	56.00	476	300	176
Alfalfa	6.0	ton	24.30	146	100	46
Pasture	11.0	AUM[a]	7.00[c]	77	46	31
Sugar beets	19.0	ton	13.20[d]	251	178	73
Beans, dry	12.0	cwt.	10.50	126	97	29
Corn, field	40.0	cwt.	3.50	140	100	40
Rice	30.0	cwt.	4.60	138	96	42
Milo	23.0	cwt.	3.10	71	51	20
Tomatoes, processing	17.0	ton	25.00	425	319	106
Melons and others	200	crate	2.40	480	400	80
Dry farmed						
Almonds	600	lbs.	0.25[b]	150	139	12
Prunes	1.0	ton	180.00	180	160	20
Walnuts	900	lbs.	0.22[b]	198	170	28
Small grains						
Rotation	20	cwt.	2.70	54	35	19
Other	6	cwt.	2.70	16	10	6
Pasture	2	AUM[a]	7.00[c]	14	10	4
Native vegetation	1	AUM[a]	7.00[c]	7	5	2

a - Animal unit month.

b - Price differential allows for better shelling quality with irrigation.

c - Based on pre-cut alfalfa equivalent price.

d - Includes subsidy payments.

The irrigation benefit for each of these projects was then evaluated as the increase in net farm income for the service area over and above the net farm income for the service area under preproject conditions.

The results of irrigation benefit computations for each project are presented in Chapter III.

Flood Control Benefits

Analyses of the proposed Wilson Valley and Guinda Projects were made to determine the benefits that would accrue from the protection afforded by flood control operations. Flood control benefits would accrue to areas downstream from Guinda Reservoir, and approximately the same annual benefits would be realized from the creation of similar facilities at Wilson Valley. In order to determine a preliminary estimate of the annual value of flood control benefits, an informal discussion was held between the Corps of Engineers and the Department of Water Resources. This resulted in a tentative agreement on the amount of flood control benefits that would accrue from a storage reservation for flood control only of 65,000 acre-feet on Cache Creek.

In the analysis of flood control benefits resulting from the operation of Wilson Valley Reservoir, it was indicated that the reservation of flood control storage and the installation of flood control outlet works would not be economically justified for a reservoir with a storage capacity of 300,000 acre-feet, but a flood control storage reservation of 65,000 acre-feet would be justified for a reservoir with a storage capacity of 1,000,000 acre-feet. However, it should be noted that the inherent regulatory effect of

the smaller reservoir would reduce peak flood discharge and would result in appreciable incidental flood control benefits. No evaluation of incidental flood control benefits was made for this study.

The protection of real estate from loss or damage by floodwaters would result in appreciable benefits to the area. Additionally, there would be a reduction in crop losses from land temporarily removed from production and from the interruption of business and trade.

Recreation Benefits

The construction of either Wilson Valley or Guinda Reservoirs would enhance recreation opportunities by providing a setting for the development of facilities such as camp sites, boating facilities, and summer homes. Also, additional recreation opportunities would result from the enhancement of flows in the Cache Creek channel. It should be noted that because of the proximity of Clear Lake, recreation development may be somewhat retarded as compared with reservoirs in areas with fewer existing facilities.

Because of legislative limitations placed on the studies for this report, the monetary value of recreation benefits that would accrue from the two projects was not evaluated. There are indications, however, that Wilson Valley Reservoir would provide greater benefit to fishing and water-associated recreation than would Guinda Reservoir. Further, Wilson Valley Reservoir would provide an opportunity for the improvement of an additional 23 miles of stream for fish and wildlife enhancement than would be provided by Guinda Reservoir. In selecting and authorizing a project for construction in the Cache Creek Basin, the recreation benefits for each proposed project should be evaluated and suitable areas adjacent to the reservoir should be reserved for recreation use and development.

An alternative method of operating the projects to that presented herein to enhance the recreational aspects of Clear Lake should be evaluated. Consideration should be given to a method of operation whereby Clear Lake fluctuations would be held to a minimum, except during the critical dry period, and all releases would be made from the storage reservoir on the main stem of Cache Creek. Under an alternative plan of operation, involving minimum fluctuation in the water surface of Clear Lake, recreational use of the downstream reservoir would be affected adversely. The recreational benefits that would accrue under such a plan should be evaluated prior to decision on the plan of operation for the project.

Hydroelectric Power Benefits

Because of limitations imposed on this study, no investigation was made of possible hydroelectric power developments as a result of additional storage on Cache Creek. Future study of major water conservation projects in Cache Creek Basin should give consideration to multipurpose operation which would include hydroelectric power generation.

CHAPTER III. WILSON VALLEY AND GUINDA PROJECTS

This chapter sets forth the general features and estimates of costs of the projects considered for the Wilson Valley and Guinda sites and an estimate of the benefits that would accrue therefrom. Based upon these data, projects will be compared in a subsequent chapter with reference to accomplishments and the relationship between benefits and costs.

Investigation of the Wilson Valley reservoir site included a study of the hydrology of the basin and the water requirements of the service area in order to establish the general features of the project. It also included geologic studies and an investigation of available construction materials to provide the basis for design of the physical features of the project. Finally, the costs of the project and its accomplishments, in terms of water yield, flood control, and recreation potential, were determined.

In order to encompass the range of possibilities of the Wilson Valley site, four sizes of reservoir were considered. The smallest project considered would have a storage capacity of 300,000 acre-feet, comparable in size to that of the Guinda Project. The largest project considered would have a storage capacity of 1,000,000 acre-feet. Between these limits, studies of other sizes of proposed projects established a scale, or "yard stick", from which the project possessing the maximum benefits in relation to costs could be selected.

As previously discussed in Chapter II, project benefits from irrigation water were computed as the increase in net farm income that would be realized as a result of the change from pre-project to project conditions. Flood control benefits were determined jointly with the United States Corps of Engineers. Recreation

benefits, however, were studied only to the extent required to establish their probable existence but were not evaluated in monetary terms.

No additional engineering investigation was performed in connection with the Guinda Project. However, the features of this project are presented in this chapter for comparative purposes. The costs of the Guinda Project were increased by standard cost index factors in order to approximate current costs of construction. However, no adjustment was made to account for additional costs resulting from increases in the estimated cost of relocating State Highway No. 16 around the reservoir, nor for increases in the estimated cost of the spillway structure required to pass the current revised estimate of flood flow. Estimates of benefits that would accrue to the Guinda Project were reviewed during this investigation and adjusted so as to be comparable with those determined for the Wilson Valley Project.

Preproject Conditions

A theoretical standard of comparison for the Project Area was used as the basis for the evaluation of gains or loss in net farm income resulting from the development of a water resources project. This standard is termed "preproject conditions", and is assumed to be an average condition throughout the period of analysis. It was assumed that the historical average seasonal diversion of 105,000 acre-feet at Capay Dam on Cache Creek near Capay would be the water supply available to the service area. This diversion was reduced by 20 per cent to account for conveyance losses. The quantity of water was then distributed to lands supporting an average crop pattern,

based on previously discussed unit values of water requirement and the recent crop pattern. Table 5 illustrates the derivations of the resultant average net farm income used as the base from which project benefits were determined.

Enlargement of Clear Lake Outlet

As previously stated, water supply studies for this investigation were made under the assumption that the Clear Lake outlet channel would be enlarged. The former Division of Water Resources recommended, in its "Report on Clear Lake-Cache Creek Flood Control Investigation", 1939, that the outlet be enlarged to a capacity of 8,500 second-feet when a lake level of elevation 7.56 feet existed on the Rumsey gage. The existing outlet capacity with the lake at 7.56 feet is about 2,500 second-feet. The maximum flow is now limited by the Grigsby Riffle rather than the Clear Lake Impounding Dam. Improvements to the outlet channel would permit lake level control and thereby alleviate flood damage to suburban and recreation developments on the perimeter of Clear Lake.

Enlargement of the channel capacity would require modification of the Gopcevic Decree and dismissal of the Bemmerly Decree. Clear Lake would continue to be operated within the levels specified in the Gopcevic Decree, but the restriction against deepening the channel over four feet below zero on the Rumsey gage would be removed. Dismissal of the Bemmerly Decree should be possible when a water conservation and flood control project providing flood protection for lands along Cache Creek in Yolo County is constructed.

It has been previously estimated that the enlargement of the Clear Lake outlet could be made at a capital cost of approximately

TABLE 5

ESTIMATED AVERAGE NET FARM INCOME UNDER
PREPROJECT CONDITIONS IN PROJECT AREA

Land utilization and crop pattern	Area: Per cent	Area: Acres	Seasonal farm delivery: Acre-feet per acre	Seasonal farm delivery: Total, in acre-feet	Annual net farm income: Per acre, in dollars	Annual net farm income: Total, in dollars
Irrigated Land						
Field crops						
Alfalfa	2.5	4,000	3.5	14,000	46	184,000
Pasture	1.9	3,000	4.3	12,900	31	93,000
Rice	2.3	3,700	9.0	33,300	42	155,000
Sugar beets	1.5	2,500	2.4	6,000	72	180,000
Tomatoes	1.3	2,000	2.7	5,400	106	212,000
Others	3.0	4,800	2.1	10,100	53	255,000
Subtotals	12.5	20,000	-	81,700	-	1,079,000
Orchards						
Almonds	.8	1,200	2.0	2,400	178	214,000
Apricots	.1	200	2.7	500	185	37,000
Others	.1	100	3.0	300	173	17,000
Subtotals	1.0	1,500	-	3,200	-	268,000
Fallow (dry-farmed grain)	2.5	4,000	-	-	19	76,000
Subtotals	2.5	4,000	-	-	-	76,000
Subtotals, Irrigated Land	16.0	25,500	-	84,900	-	1,423,000
Dry-farmed Land						
Field crops						
Small grains	44.4	70,600	-	-	6	424,000
Pasture	16.5	26,200	-	-	4	105,000
Others	.9	1,200	-	-	4	5,000
Subtotals	61.8	98,000	-	-	-	534,000
Orchards						
Almonds	2.2	3,500	-	-	12	42,000
Others	.1	200	-	-	13	3,000
Subtotals	2.3	3,700	-	-	-	45,000
Fallow	11.0	17,500	-	-	-	-
Subtotals	11.0	17,500	-	-	-	-
Subtotals, Dry-farmed Land	75.1	119,200	-	-	-	579,000
Native Vegetation	8.9	14,000	-	-	2	28,000
Subtotals, Native Vegetation	8.9	14,000	-	-	-	28,000
TOTALS, PROJECT AREA	100.0	158,700	-	85,000*	-	2,030,000

* Estimated quantity of water delivered at farm head gates, based on average annual diversion of 105,000 acre-feet at Capay Dam, with an 80 per cent conveyance system efficiency.

$700,000, exclusive of costs of rights of way. This cost is based on prices prevailing in the fall of 1954. Flood control benefits to lands abutting the shore of the lake are estimated to be greater than the cost of the enlargement, and such enlargement should therefore be considered as a separate project. This enlargement would have no effect on the yield of the projects considered in this report and for that reason, the cost was not considered in the evaluation and comparison of costs and benefits from the projects proposed.

Wilson Valley Project

The Wilson Valley Project consists of a dam and reservoir in Wilson Valley to regulate the waters of Cache Creek, provide irrigation water in Capay Valley and other portions of Yolo County, provide flood control to the land and structures located downstream from the reservoir, and enhance the recreational possibilities of Cache Creek.

Wilson Valley Reservoir would be created by construction of a dam on the main stem of Cache Creek about 5 miles downstream from its confluence with the North Fork, or about 8 miles downstream from California State Highway Route 20. Several alternative dam sites were investigated in selecting the site for the Wilson Valley Dam. The recommended site, referred to as the lower site, was selected as a result of foundation exploration, engineering design considerations, and economic analysis. The lower site is in the southeast quarter of Section 19, Township 13 North, Range 5 West, Mt. Diablo Base and Meridian. The stream bed elevation at the site is 867 feet.

Wilson Valley is a reach of flat land extending along Cache Creek, downstream from the mouth of Rocky Creek, for a distance of

about 2.5 miles. It is a remote area, accessible by a dirt road, extending southward from the Cache Creek crossing of California State Route 20. Wilson Valley, as well as the canyon of the North Fork of Cache Creek, would be completely inundated by a reservoir with a storage capacity of 1,000,000 acre-feet. Further, portions of California State Route 20 would require relocation.

Storage capacities and corresponding surface areas of Wilson Valley Reservoir at various stages of water surface elevation are given in Table 6.

TABLE 6

AREAS AND CAPACITIES OF WILSON VALLEY RESERVOIR

Water surface elevation, in feet	Area, in acres	Capacity, in acre-feet
867	0	0
880	20	100
920	200	3,400
960	600	19,000
1,000	1,200	52,000
1,040	2,000	114,000
1,080	2,800	208,000
1,108	3,600	300,000
1,140	4,600	428,000
1,180	6,200	648,000
1,220	8,000	932,000
1,228	8,400	1,000,000

Geologic Considerations

Based on the findings of a dam site foundation exploration program, the Wilson Valley dam site is considered geologically suitable for dams of the heights being considered. The geologic formations found at the site area are sedimentary rocks of probable Upper Jurassic age, unconsolidated deposits laid down in former lake beds and by stream action during the Plio-Pleistocene age, and Recent terrace and alluvial deposits.

The terrace deposits are found to occur in the major portion of Wilson Valley, the only exception being the present channel area of Cache Creek. These deposits consist of well compacted light brown to tan silts underlain by coarse, gray-brown sandy and gravelly silts. The stream channel material is primarily highly pervious loose sand, gravel, and cobbles, bound in some zones by a matrix of red, sandy clay.

General structural features of this region of the Coast Range are large complex folds, several miles in length and moderately narrow. The axes of the folds have a northwestward trend. Associated faults dip steeply and trend in the same direction.

The general topography of this region consists of irregular hilly areas, in which the drainage is generally adjusted to the northwest structural trend. However, the stream pattern is complex, with many irregular gullies that enter the main stream channels more or less normal to its direction of flow. Most of the region, including the stream valleys, is now in a stage of early maturity. Several irregular flatbottom valleys, such as Wilson Valley, have developed within the area.

The foundation rock at the lower site, except for the stream channel deposits, consists entirely of lithologic units of the Knoxville group. The Knoxville units include, in decreasing order of occurrence, silty sandstones, siltstones, and silty shales. Veins of calcite or forms of calcium carbonate are present locally. The Knoxville beds strike across the channel and dip rather steeply upstream. The Recent alluvial deposits appearing in the Cache Creek channel at the dam site consist of highly pervious sand, gravel, and small cobbles.

Both abutments consist of interlayered beds of Knoxville sandstones and siltstones with minor quantities of shales. The fractured nature of the material underlying the abutments would require only a moderate amount of grouting.

Recent alluvial and stream channel deposits cover the channel section to a maximum depth of 12 feet. Beneath the channel in this section the Knoxville formations are fractured for a depth of about 30 feet. Drill cores showed that these siltstones, sandstones, and shales in the channel were good foundation rock capable of supporting an earthfill dam when adequately grouted. No evidence of major faulting was apparent in the drill cores.

The entire spillway area on the left abutment is underlain by mudstones, siltstones, and sandstones of the Knoxville group. An extensive trenching exploration was conducted to determine foundation conditions in the spillway area. The properties of the materials to be excavated from the spillway were determined with a view to possible use in the dam embankment. As a result of laboratory analysis, it is estimated that an appreciable percentage of the excavated material is suitable for use in the construction of the dam.

The topography of the spillway section is such that a considerable quantity of excavation will be required. This can be reduced to a minimum, however, by the expedient of benching at regular vertical intervals, permitting the stabilization of the foundation material on a 1 to 1 slope. It will be necessary, in order to prevent erosion and undercutting of the foundation material, to line the entire spillway and provide for the installation of cutoff curtains.

A detailed description of the geologic conditions of the Wilson Valley dam site and the location of possible construction materials can be found in Appendix C.

Reservoir Capacity Considerations

As previously stated, estimates of costs and benefits for a Wilson Valley Reservoir with a storage capacity of about 300,000 acre-feet were made in order to compare the alternative Wilson Valley and Guinda Projects. This is approximately the same capacity as that established for the Guinda Reservoir proposed in the interim report of March, 1955. In addition, estimates of cost and the benefits that would be derived were determined for a Wilson Valley Reservoir with capacities of 550,000, 830,000, and 1,000,000 acre-feet. The studies of the larger capacities were preliminary and were made primarily for the purpose of determing the capacity that would provide the maximum net benefit.

Pertinent data for a reservoir at the Wilson Valley site comparable to the Guinda Reservoir, and for a reservoir that approaches the capacity which would yield the maximum net benefit, are presented in the following sections.

Wilson Valley Reservoir With Storage Capacity of 300,000 Acre-feet

A Wilson Valley Reservoir with storage capacity of about 300,000 acre-feet would provide a regulated supply of about 142,000 acre-feet of water seasonally on a firm yield basis for use in Capay Valley and other portions of Yolo County. This amount of water released for beneficial uses includes both new yield and the presently utilized unregulated water supply reregulated to a firm yield basis.

Through the use of surcharge storage the project would provide incidental flood control benefits, as a result of the reduction of flood peaks downstream from the reservoir. It was estimated that a once-in-1,000-year flood peak inflow would be reduced from about 84,000 second-feet to peak outflow of 63,000 second-feet. It was further estimated that a once-in-100-year flood peak would be reduced from about 60,000 second-feet to about 33,000 second-feet.

The reservoir would provide a setting for the development of recreational facilities in the surrounding area, and would facilitate the improvement of the stream flow of Cache Creek, downstream from the dam, for fish and wildlife purposes.

The location of Wilson Valley Dam and Reservoir is shown on Plate 1, and its principal features are delineated on Plate 3.

In consideration of results of geologic investigation of the dam site, a preliminary design for an earthfill dam was made to provide the basis for estimating the cost of a Wilson Valley Reservoir with a storage capacity of 300,000 acre-feet.

General Features. The dam would have a height of 262 feet above stream bed, a crest length of 860 feet, a crest width of 30 feet, an upstream side slope of 3:1, and a downstream side slope of 2:1. It would contain an impervious core of compacted earth, with side slopes of 0.5:1. The core would be contained within upstream and downstream stability sections composed of stream bed gravels and material from spillway excavation. The total volume of embankment would be about 2,960,000 cubic yards, including 750,000 cubic yards of selected material in the impervious core.

A concrete-lined side channel spillway would be constructed across the left abutment. The design discharge capacity would be 63,000 second-feet, with a maximum depth of water of 15 feet above the spillway lip. An additional 6 feet of freeboard would be provided.

The spillway design capacity was determined from a flood routing study based on flood frequency analyses of stream flow records. It was estimated that the design flood would result from a runoff of 230 second-feet per square mile for the Clear Lake drainage area, and 260 second-feet per square mile for drainage area below Clear Lake, including that of the North Fork of Cache Creek.

During construction of the dam, the stream would be diverted through a 28-foot-diameter tunnel, about 1,150 feet in length, constructed through the right abutment. After completion of the dam, the tunnel would become a part of the outlet works releasing water into the stream channel. The inlet for the tunnel would consist of a sloping trashrack covering a transition structure providing access to the 28-foot-diameter tunnel. Two 60-inch-diameter steel pipes would be installed, extending from the outlet structure to a gate

chamber and tunnel plug located approximately on the axis of the dam. The gate chamber would contain two 4 x 4-foot pressure slide gates for controlling releases. The outlet structure would contain two 54-inch-diameter Howell-Bunger type valves, controlling releases made into a lined chute located near the downstream toe of the dam.

The area that would be inundated by Wilson Valley Reservoir is sparsely settled open range presently utilized for livestock grazing. About 10 miles of California State Highway Route 20 would require relocation.

Pertinent data with respect to general features of Wilson Valley Reservoir, as designed for cost estimating purposes, are presented in Table 7.

TABLE 7

GENERAL FEATURES OF WILSON VALLEY RESERVOIR
WITH STORAGE CAPACITY OF 300,000 ACRE-FEET

Dam	
Type	earthfill
Crest elevation, in feet	1,129
Crest length, in feet	860
Crest width, in feet	30
Height above stream bed, in feet	262
Freeboard, in feet	6
Side slopes	
Upstream	3:1
Downstream	2:1
Elevation of stream bed, in feet	867
Volume of fill, in cubic yards	2,960,000
Reservoir	
Surface area, at spillway lip, in acres	3,600
Storage capacity at spillway lip, in acre-feet	300,000
Drainage area, in square miles	800
Average seasonal runoff, in acre-feet	372,000
Seasonal yield of water, in acre-feet	142,000
Type of spillway	lined side channel
Spillway discharge capacity, in second-feet	63,000
Types of outlets	Two 60-inch-diameter steel pipes in tunnel through right abutment

Costs. The capital cost of Wilson Valley Reservoir, with a storage capacity of 300,000 acre-feet, was estimated to be about $17,600,000, and the corresponding annual costs, using an interest rate of 4 per cent per annum and an amortization period of 50 years, were estimated to be about $914,000. A detailed cost estimate is presented in Appendix B. A summary of capital and annual costs for major portions of the project is presented in Table 8.

TABLE 8

SUMMARY OF ESTIMATED COSTS OF WILSON VALLEY PROJECT WITH RESERVOIR STORAGE CAPACITY OF 300,000 ACRE-FEET

(Based on prices prevailing in fall of 1957)

Item	Capital costs	Annual costs
Dam and appurtenances	$10,760,000	
Lands, easements, rights of way, and clearing	880,000	
Relocation of public utilities	5,990,000	
Interest and capital recovery		$820,000
Operation, maintenance, replacement, and general expense		94,000
TOTALS	$17,630,000	$914,000

Primary Benefits. Benefits from the construction and operation of Wilson Valley Reservoir would accrue from the regulation of water for irrigation use, from flood protection to downstream areas, and from recreational enhancement.

As previously stated, studies indicated that the cost of providing specific flood control features in a reservoir of 300,000 acre-foot storage capacity would not be economically justified. Furthermore, the reduction in yield due to maintenance of a

flood control reservation would be excessive in relation to the benefits derived. Nevertheless, operation of the reservoir without the flood control features would provide incidental flood control benefits, although these incidental benefits were not evaluated. Additionally, for the purposes of this report, no attempt was made to evaluate the recreational benefits that would accrue following project development. Therefore, the economic justification of the project with 300,000 acre-feet of storage capacity was based solely on the resulting irrigation benefits.

The irrigation benefits that would accrue from the project would consist of the increase in long-term average net farm income that would be realized from the application of project water. An estimate of the total average annual net farm income resulting from the regulation of water in a 300,000 acre-foot capacity reservoir at Wilson Valley is presented in Table 9.

As previously demonstrated, the average annual net farm income, under preproject conditions, was estimated to be $2,030,000. Deducting this amount from the average annual net farm income of $4,380,000 (Table 9), the average annual irrigation benefit would amount to $2,350,000 at the farm head gate.

Benefit-Cost Ratio. The ratio of irrigation benefits to project costs for the Wilson Valley Project with a storage capacity of 300,000 acre-feet would be about 2.6 to 1.

TABLE 9

ESTIMATED AVERAGE ANNUAL NET FARM INCOME IN PROJECT AREA WITH 300,000 ACRE-FOOT CAPACITY RESERVOIR AT WILSON VALLEY

Land utilization and crop pattern	Area		Seasonal farm delivery		Annual net farm income	
	Per cent	Acres	Acre-feet per acre	Total, in acre-feet	Per acre, in dollars	Total, in dollars
Irrigated Land						
Field crops						
Alfalfa	3.1	4,900	3.5	17,000	46	226,000
Pasture	3.1	4,900	4.3	21,000	31	152,000
Sugar beets	6.1	9,700	2.4	24,000	73	708,000
Beans, milo, corn	1.2	1,900	2.1	4,000	29	55,000
Subtotals	13.5	21,400	-	66,000	-	1,141,000
Truck crops						
Tomatoes	4.3	6,800	2.7	19,000	106	720,000
Melons	.9	1,400	2.1	3,000	80	112,000
Others	.9	1,500	2.1	3,000	80	120,000
Subtotals	6.1	9,700	-	25,000	-	952,000
Orchards						
Almonds	3.7	5,800	2.0	12,000	178	1,032,000
Apricots	.6	1,000	2.7	3,000	185	185,000
Prunes	.6	1,000	2.7	2,000	110	110,000
Walnuts, peaches	1.2	1,900	3.3	6,000	175	333,000
Subtotals	6.1	9,700	-	23,000	-	1,660,000
Fallow (dry-farmed grain)	4.5	7,200	-	-	19	137,000
Subtotals	4.5	7,200	-	-	-	137,000
Subtotals, Irrigated Land	30.2	48,000	-	114,000	-	3,890,000
Dry-farmed Land						
Field crops						
Small grains	35.2	55,900	-	-	6	335,000
Pasture	13.3	21,100	-	-	4	84,000
Others	.6	1,000	-	-	4	4,000
Subtotals	49.1	78,000	-	-	-	423,000
Orchards						
Almonds	1.9	3,000	-	-	12	36,000
Others	.1	200	-	-	13	3,000
Subtotals	2.0	3,200	-	-	-	39,000
Fallow	9.8	15,500	-	-	-	-
Subtotals	9.8	15,500	-	-	-	-
Subtotals, Dry-farmed Land	60.9	96,700	-	-	-	462,000
Native Vegetation	8.9	14,000	-	-	2	28,000
Subtotals, Native Vegetation	8.9	14,000	-	-	-	28,000
TOTALS, PROJECT AREA	100.0	158,700	-	114,000*	-	4,380,000

* Estimated quantity of water delivered at farm head gates, based on average annual diversion of 142,000 acre-feet at Capay Dam, with an 80 per cent conveyance system efficiency.

Wilson Valley Reservoir With Storage Capacity of 1,000,000 Acre-Feet

A Wilson Valley Reservoir with a storage capacity of 1,000,000 acre-feet would provide a regulated supply of about 252,000 acre-feet of water seasonally on a firm yield basis for use in Capay Valley and other portions of Yolo County. This supply would include both new yield and the presently used unregulated water supply reregulated to a firm yield basis.

The criteria for determining operational accomplishments of the project included a reservation of 65,000 acre-feet for flood control purposes during the period from November 1 to April 1 of each year. As a result of operation with this storage reservation, it was estimated that the peak inflow resulting from a once-in-1,000-year flood would be reduced from about 84,000 second-feet to a peak outflow of about 30,000 second-feet. It was further estimated that a once-in-100-year flood, resulting in a peak inflow of about 60,000 second-feet, would be reduced to a peak outflow of about 15,000 second-feet.

The reservoir would provide a setting for the development of recreational facilities in the surrounding area and would facilitate the improvement of the stream flow of Cache Creek for fish and wildlife purposes.

The location of the project is shown on Plate 1, and its principal features are delineated on Plate 4.

In consideration of the geologic investigation of the dam site and preliminary engineering designs, an earthfill dam was designed to provide the basis for estimating the cost of a Wilson Valley Reservoir with a storage capacity of about 1,000,000 acre-feet.

General Features. The dam would have a height of 377 feet above stream bed, a crest length of 1,340 feet, a crest width of 30 feet, an upstream side slope of 3:1, and a downstream side slope of 2.25:1. It would contain an impervious core of compacted earth, within stability sections composed of stream bed gravels. The total volume of fill would be about 8,600,000 cubic yards, including 2,000,000 cubic yards of selected impervious embankment.

A concrete-lined side channel spillway would be constructed across the left abutment. The design discharge capacity, estimated to be 45,000 second-feet with a maximum depth of water of 10 feet above the spillway lip, was based on the assumption that the design flood would occur after the flood control storage reservation was filled, and only surcharge storage was available. An additional 6 feet of freeboard would be provided. The spillway design capacity was determined from a flood routing study, based on a flood frequency analysis of stream flow records.

During construction of the dam the stream would be diverted through a 28-foot-diameter tunnel, about 1,680 feet in length, constructed through the right abutment. After construction of the dam the tunnel would become part of the outlet works, releasing water into the stream channel. The inlet for the tunnel would consist of a sloping trashrack covering a transition structure providing access to the tunnel. Two 72-inch-diameter steel pipes would be installed, extending from the outlet structure to a gate chamber and tunnel plug located just upstream from the axis of the dam. The gate chamber would contain two 4-1/2 x 4-1/2-foot pressure slide gates for controlling releases. The outlet structure would contain two

66-inch-diameter Howell-Bunger type valves, controlling releases into a lined chute located near the downstream toe of the dam.

Releases to the stream channel below the dam for flood control purposes would be made through a 30 by 40-foot radial gate, located at the upstream end of the spillway inlet structure. The gated portion of the flood control outlet structure was designed for a capacity of 15,000 second-feet.

The area that would be inundated by Wilson Valley Reservoir is sparsely settled upon range presently utilized for livestock grazing. About 10 miles of California State Highway Route 20 would require relocation.

Pertinent data with respect to general features of Wilson Valley Reservoir with 1,000,000 acre-feet of storage capacity, as designed for cost estimating purposes, are presented in Table 10.

Costs. The capital cost of a Wilson Valley Reservoir with a storage capacity of 1,000,000 acre-feet was estimated to be about $31,600,000, and the corresponding annual costs, using an interest rate of 4 per cent per annum, and an amortization period of 50 years, were estimated to be about $1,660,000. A detailed cost estimate is presented in Appendix B. A summary of capital and annual costs is presented in Table 11.

TABLE 10

GENERAL FEATURES OF WILSON VALLEY RESERVOIR
WITH STORAGE CAPACITY OF 1,000,000 ACRE-FEET

Dam	
Type	earthfill
Crest elevation, in feet	1,244
Crest length, in feet	1,340
Crest width, in feet	30
Height above stream bed, in feet	377
Freeboard, in feet	6
Side slopes	
Upstream	3:1
Downstream	2.25:1
Elevation of stream bed, in feet	867
Volume of fill, in cubic yards	8,600,000
Reservoir	
Surface area at spillway lip, in acres	8,400
Storage capacity at spillway lip, in acre-feet	1,000,000
Drainage area, in square miles	800
Average seasonal runoff, in acre-feet	372,000
Seasonal yield of water, in acre-feet	252,000
Type of spillway	lined side channel
Spillway discharge capacity, in second-feet	45,000
Type of conservation outlet works	Two 72-inch-diameter steel pipes in tunnel through right abutment
Type of flood control outlet	30 ft. by 40 ft. radial gate in upstream end of spillway inlet structure

TABLE 11

SUMMARY OF ESTIMATED COSTS OF WILSON VALLEY PROJECT
WITH RESERVOIR STORAGE CAPACITY OF 1,000,000 ACRE-FEET

(Based on prices prevailing in fall of 1957)

Item	Capital costs	Annual costs
Dam and appurtenances	$23,570,000	
Lands, easements, rights of way and clearing	2,030,000	
Relocation of public utilities	5,990,000	
Interest and capital recovery		$ 1,470,000
Operation, maintenance, replacement, and general expense		190,000
TOTALS	$31,590,000	$ 1,660,000

Primary Benefits. As previously stated, primary benefits from the construction and operation of Wilson Valley Reservoir would accrue from the regulation of water for irrigation use, from flood protection to downstream areas, and from recreational enhancement. The recreational benefits that would accrue from the project involving a 1,000,000 acre-foot reservoir, were not evaluated, and the determination of economic justification was made on the basis of the flood control and irrigation benefits.

Flood control benefits were evaluated on the basis that a reservation of 65,000 acre-feet of reservoir storage would be made for flood control purposes during the period from November 1 to April 1. Suitable outlet works with a discharge capacity of 15,000 second-feet would be provided in order that the flood control storage space could be made available. The estimate of preliminary annual flood control benefits resulting from flood protection to lands below the reservoir would be about $160,000, based on 1957 prices.

The irrigation benefits would consist of the increase in long-term average net farm income that would be realized from the application of project water. An estimate of the total average annual net farm income resulting from the regulation of water in a 1,000,000 acre-foot capacity reservoir at Wilson Valley is presented in Table 12.

As previously demonstrated, the average annual net farm income under preproject conditions was estimated to be $2,030,000. Deducting this amount from the average annual net farm income of $7,285,000 (Table 12), the average annual net irrigation benefit would amount to about $5,255,000 at the farm head gate.

TABLE 12

ESTIMATED AVERAGE ANNUAL NET FARM INCOME IN PROJECT AREA WITH 1,000,000 ACRE-FOOT CAPACITY RESERVOIR AT WILSON VALLEY

Land utilization and crop pattern	Area		Seasonal farm delivery		Annual net farm income	
	Per cent	Acres	Acre-feet per acre	Total, in acre-feet	Per acre, in dollars	Total, in dollars
Irrigated Land						
Field crops						
Alfalfa	5.4	8,500	3.5	30,000	46	391,000
Pasture	5.4	8,500	4.3	37,000	31	264,000
Sugar beets	10.8	17,200	2.4	41,000	73	1,256,000
Beans, milo, corn	2.3	3,700	2.1	8,000	29	107,000
Subtotals	23.9	37,900	-	116,000	-	2,018,000
Truck crops						
Tomatoes	7.6	12,100	2.7	33,000	106	1,283,000
Melons	1.7	2,700	2.1	6,000	80	216,000
Others	1.7	2,700	2.1	6,000	80	216,000
Subtotals	11.0	17,500	-	45,000	-	1,715,000
Orchards						
Almonds	6.5	10,400	2.0	21,000	178	1,850,000
Apricots	1.1	1,700	2.7	4,000	185	314,000
Prunes	1.1	1,700	2.7	4,000	110	187,000
Walnuts, peaches	2.3	3,700	3.3	12,000	175	648,000
Subtotals	11.0	17,500	-	41,000	-	2,999,000
Fallow (dry-farmed grain)	7.0	11,100	-	-	19	211,000
Subtotals	7.0	11,100	-	-	-	211,000
Subtotals, Irrigated Land	52.9	84,000	-	202,000	-	6,943,000
Dry-farmed Land						
Field crops						
Small grains	24.5	38,900	-	-	6	233,000
Pasture	9.3	14,700	-	-	4	59,000
Others	0.5	800	-	-	4	3,000
Subtotals	34.3	54,400	-	-	-	295,000
Orchards						
Almonds	1.3	2,000	-	-	12	24,000
Others	0.1	200	-	-	13	3,000
Subtotals	1.4	2,200	-	-	-	27,000
Fallow	5.1	8,100	-	-	-	-
Subtotals	5.1	8,100	-	-	-	-
Subtotals, Dry-farmed Land	40.8	64,700	-	-	-	322,000
Native Vegetation	6.3	10,000	-	-	2	20,000
Subtotals, Native Vegetation	6.3	10,000	-	-	-	20,000
TOTALS, PROJECT AREA	100.0	158,700	-	202,000*	-	7,285,000

* Estimated quantity of water delivered at farm head gates, based on average annual diversion of 252,000 acre-feet at Capay Dam, with an 80 per cent conveyance system efficiency.

The average annual benefits that would accrue from construction and operation of Wilson Valley Reservoir, with a storage capacity of 1,000,000 acre-feet, are summarized in Table 13.

TABLE 13

ESTIMATED AVERAGE ANNUAL NET BENEFITS FROM WILSON VALLEY PROJECT WITH RESERVOIR STORAGE CAPACITY OF 1,000,000 ACRE-FEET

Item	Benefits
Irrigation	$ 5,255,000
Flood control	160,000
Total	$ 5,415,000

Benefit-Cost Ratio. The ratio of project benefits to project costs for the Wilson Valley Project with a storage capacity of 1,000,000 acre-feet would be about 3.2 to 1.

Guinda Project

The Guinda Project would consist of a dam, creating a reservoir with storage capacity of about 303,000 acre-feet, on Cache Creek in Capay Valley. It would provide water for irrigation use in Capay Valley and in other portions of Yolo County; provide incidental flood protection to lands and structures located downstream from the reservoir; and enhance the recreational potentialities of Cache Creek.

As described in the interim report of March, 1955, Guinda Dam would be an earthfill structure across Capay Valley, about 1.5 miles north of the town of Guinda. It would be located in Sections 32 and 33, Township 12 North, Range 3 West. Stream bed elevation at the dam site is about 350 feet, USGS datum.

Storage capacities and corresponding surface areas of Guinda Reservoir at various stages of water surface elevation are given in Table 14.

TABLE 14

AREAS AND CAPACITIES OF GUINDA RESERVOIR

Water surface elevation, in feet	Area, in acres	Capacity, in acre-feet
350	0	0
380	300	3,000
400	950	16,000
420	1,600	42,000
440	2,400	82,000
460	2,900	134,000
480	3,300	197,000
500	3,700	267,000
510	3,800	303,000

Results of geologic exploration indicate that the Guinda site is geologically suitable for an earthfill dam of the height being considered. Foundation rock at the proposed dam site consists of consolidated sandstone and shale of the Capay formation of Eocene age, overlain on the abutments by semi-consolidated sandy and clayey silt conglomerate of the Tehama formation, and by unconsolidated Pleistocene and Recent sediments in the valley floor. Consolidated sandstone and shale of cretaceous age underlies the site at considerable depth beneath these younger sediments. The Tehama formation forms the foundation rock of both the left and right abutments, both of which rise on moderately steep slopes.

The floor of Capay Valley is about one and one-third miles in width at the site. Cache Creek is located near the left abutment, where the present channel and the broad overflow channel are incised into the terrace deposits. The terrace deposits, composed of unconsolidated gravel with sand and silt, extend the full width of the valley, and vary in depth from 10 feet near the creek channel to as much as 60 feet near the right abutment on the western side of Capay Valley. Neither the drilling program nor the seismic survey conducted during the geologic exploration revealed any impermeable strata in the terrace deposits, and it is believed that a cut-off to the underlying Tehama formation would be required to prevent excessive leakage from Guinda Reservoir.

Guinda Reservoir With Storage Capacity of 303,000 Acre-Feet

Re-evaluation of the available water supply data for the purpose of determining the yield of reservoirs at the Wilson Valley site on Cache Creek indicated that the yield from Guinda Reservoir would be greater than heretofore estimated. The reservoir storage capacity at the Guinda site for both the current and previous reservoir yield studies was 303,000 acre-feet.

The 1955 interim report indicated that the firm seasonal irrigation yield of Guinda Reservoir, based on yield studies for the critical period from 1927 through 1935, would be 112,000 acre-feet, with a deficiency of not more than 35 per cent in any one year. In addition, a firm seasonal supply of 19,000 acre-feet was provided in the yield studies for release to the Cache Creek channel below Guinda dam site for ground water recharge. Thus, the previously

estimated total firm yield of Guinda Reservoir was about 131,000 acre-feet per season. Deficiencies in the irrigation supply were estimated to be 35 per cent in 1933 and 27 per cent in 1934.

Re-evaluation of the yield studies of Guinda Reservoir during the current investigation indicated that the average seasonal release from the reservoir, not including spill, would be 172,500 acre-feet during the 45-year period from 1911-12 through 1955-56. It was estimated that of this release an average of 14,500 acre-feet per season would be lost by percolation from the stream channel between Guinda Dam and the Moore and Capay diversion dams. The resulting firm seasonal yield of Guinda Reservoir at the diversion points would be 158,000 acre-feet, with a deficiency in only one year of the 45-year period. This deficiency would have occurred in 1934, amounting to about 50 per cent of the firm yield.

This deficiency, although sizeable in quantity, is less than has occurred historically. For example, in 1947 a 75 per cent deficiency from the average supply was experienced on Cache Creek. On the other hand, the regulated yield would permit a greater quantity to be diverted seasonally for beneficial uses in the service area than would be available without such regulation. In both studies discussed above, the estimates of firm supply include both new yield and the presently used unregulated water supply.

The location of Guinda Dam and Reservoir is shown on Plate 1, and its principal features are delineated on Plate 5.

General Features. The dam would be an earthfill structure, 170 feet in height from stream bed to crest, and would have a crest length of 8,000 feet. The crest width would be 20 feet, with upstream slopes varying from 2:1 to 3.5:1, and downstream slopes

varying from 2:1, 3:1, to 3.5:1. The crest elevation would be 520 feet. The dam would be constructed with a central core of compacted selected impervious material placed symmetrically about the dam axis, with a top width of 10 feet and side slopes of 0.5:1. The core would extend into a cut-off trench excavated through the unconsolidated terrace deposits. The cut-off trench would have a bottom width of 30 feet and sides slopes of 1.5 to 1, with depths as great as 50 feet in some locations.

The upstream and downstream exterior sections of the dam would be compacted random fill obtained from the local terrace and gravel deposits. The downstream section would be provided with gravel drains. The upstream face would be protected from erosion and wave wash by a 3-foot facing of rock riprap. The volume of embankment would be about 15,600,000 cubic yards, including 2,700,000 cubic yards of selected impervious material in the core.

The spillway would be located through a saddle just east of the left abutment. The original design discharge capacity of about 40,000 second-feet has been revised on the basis of data now available, to about 70,000 second-feet. This would increase the cost of the spillway, over that previously estimated in the report of March, 1955. However, the cost used herein has not been revised, as redesign of the Guinda Project was not authorized in the current investigation.

Outlet works would consist of a 90-inch-diameter steel pipe, encased in concrete, through the left abutment. The submerged inlet to the pipe would be equipped with suitable trashracks and a hydraulically controlled slide gate. Irrigation releases of water

would be controlled by a Howell-Bunger type valve at the downstream end. The outlet pipe would be utilized for diversion of stream flow during construction.

The area flooded by Guinda Reservoir includes a well-developed portion of the upper end of Capay Valley. The reservoir would cover the entire upper valley floor as well as the lower slopes of the bordering hills, and would have an area of 3,820 acres at maximum water surface.

Most of the area is cultivated, and a large portion is irrigated. Almonds are the predominant crop in the reservoir area, covering about 30 per cent of the valley floor. Other agricultural developments include field crops, grain crops, and livestock. The portion of State Highway Route 16 that extends through the reservoir area would have to be replaced with about 6 miles of two-lane highway. About 5 miles of unpaved roads would be required to replace county roads that would be inundated. Other public utilities to be replaced would include 11 miles of electric power transmission lines and 11 miles of telephone lines.

The general features of Guinda Dam and Reservoir are shown in Table 15.

Costs. The capital cost of Guinda Reservoir with a storage capacity of 303,000 acre-feet was estimated to be about $18,065,000, and the corresponding annual costs, using an interest rate of 4 per cent per annum and an amortization period of 50 years, were estimated to be about $936,000. A detailed cost estimate is presented in Appendix B. A summary of capital and annual costs for Guinda Dam and Reservoir Project is presented in Table 16.

TABLE 15

GENERAL FEATURES OF GUINDA RESERVOIR

Dam	
Type	earthfill
Crest elevation, in feet	520
Crest length, in feet	8,000
Crest width, in feet	20
Height above stream bed, in feet	170
Freeboard above spillway lip, in feet	10
Side slopes	
Upstream	(variable) 2:1, 3.5:1
Downstream	(variable) 2:1, 3:1, 3.5:1
Elevation of stream bed, in feet	350
Volume of fill, in cubic yards	15,600,000
Reservoir	
Surface area at spillway lip, in acres	3,800
Storage capacity at spillway lip, in acre-feet	303,000
Drainage area, in square miles	992
Average seasonal runoff, in acre-feet	456,000
Seasonal yield, in acre-feet	158,000
Type of spillway	lined chute across left abutment
Spillway discharge capacity, in second feet	40,000
Type of conservation outlet works	90-inch-diameter steel pipe beneath dam
Type of flood control outlet works	22 by 75-foot submergible radial gate in spillway

TABLE 16

SUMMARY OF ESTIMATED COSTS OF GUINDA PROJECT WITH RESERVOIR STORAGE CAPACITY OF 303,000 ACRE-FEET

(Based on prices prevailing in fall of 1957)

Item	Capital costs	Annual costs
Dam and appurtenances	$12,760,000	$
Lands, easements, rights of way, and clearing	4,400,000	
Relocation of public utilities	905,000	
Interest and capital recovery		841,000
Operation, maintenance, replacement, and general expense		95,000
TOTALS	$18,065,000	$936,000

Primary Benefits. Benefits from construction and operation of the Guinda Project would accrue from the regulation of water for irrigation use, from incidental flood protection to downstream areas, and from recreational enhancement.

As previously indicated, recreational benefits that would accrue from this project were not evaluated. Furthermore, analysis of the magnitude of probable flood control benefits indicated that provision of flood control storage space in a reservoir of this capacity would not be economically justified. However, operation of the reservoir without specific flood control features would provide incidental flood control benefits. These incidental benefits were not evaluated in monetary terms, and the economic justification of the Guinda Project was based solely on the resulting irrigation benefits.

The irrigation benefits would consist of the increase in long-term average net farm income that would be realized from application of project water. An estimate of the total average annual net farm income resulting from the regulation of water in Guinda Reservoir is presented in Table 17.

As previously demonstrated, the average annual net farm income, under preproject conditions, was estimated to be $2,030,000. Deducting this amount from the average annual net farm income of $4,793,000 (Table 17), the average annual irrigation benefit would amount to $2,763,000 at the farm head gate.

Benefit-Cost Ratio. The ratio of irrigation benefits to project costs for the Guinda Project would be 2.9 to 1.

TABLE 17

ESTIMATED AVERAGE ANNUAL NET FARM INCOME IN PROJECT AREA
WITH 303,000 ACRE-FOOT CAPACITY RESERVOIR AT GUINDA

Land utilization and crop pattern	Area: Per cent	Area: Acres	Seasonal farm delivery: Acre-feet per acre	Seasonal farm delivery: Total, in acre-feet	Annual net farm income: Per acre, in dollars	Annual net farm income: Total, in dollars
Irrigated Land						
Field crops						
Alfalfa	3.4	5,400	3.5	19,000	46	248,000
Sugar beets	6.8	10,800	2.4	26,000	73	788,000
Beans, milo, corn	1.4	2,200	2.1	5,000	29	64,000
Pasture	3.4	5,400	4.3	23,000	31	168,000
Subtotals	15.0	23,800	-	73,000	-	1,268,000
Truck crops						
Tomatoes	4.8	7,600	2.7	21,000	106	806,000
Melons	1.0	1,500	2.1	3,000	80	120,000
Others	.9	1,500	2.1	3,000	80	120,000
Subtotals	6.7	10,600	-	27,000	-	1,046,000
Orchards						
Almonds	4.1	6,500	2.0	13,000	178	1,157,000
Apricots	.7	1,100	2.7	3,000	185	203,000
Prunes	.7	1,100	2.7	7,000	110	121,000
Walnuts, peaches	1.4	2,200	3.3	4,000	175	385,000
Subtotals	6.9	10,900	-	26,000	-	1,866,000
Fallow (dry-farmed grain)	4.7	7,600	-	-	19	144,000
Subtotals	4.7	7,600	-	-	-	144,000
Subtotals, Irrigated Land	33.3	52,900	-	126,000	-	4,324,000
Dry-farmed Land						
Field crops						
Small grains	33.8	53,600	-	-	6	322,000
Pasture	12.8	20,300	-	-	4	81,000
Others	.6	1,000	-	-	4	4,000
Subtotals	47.2	74,900	-	-	-	407,000
Orchards						
Almonds	1.8	2,800	-	-	12	33,000
Others	.1	200	-	-	13	3,000
Subtotals	1.9	3,000	-	-	-	36,000
Fallow	9.4	14,900	-	-	-	-
Subtotals	9.4	14,900	-	-	-	-
Subtotals, Dry-farmed Land	58.5	92,800	-	-	-	443,000
Native Vegetation	8.2	13,000	-	-	2	26,000
Subtotals, Native Vegetation	8.2	13,000	-	-	-	26,000
TOTALS, PROJECT AREA	100.0	158,700	-	126,000*	-	4,793,000

* Estimated quantity of water delivered at farm head gates, based on average annual diversion of 158,000 acre-feet at Capay Dam, with an 80 per cent conveyance system efficiency.

CHAPTER IV. COMPARISON OF WILSON VALLEY AND GUINDA PROJECTS

The comparison of engineering and economic feasibility of the alternative Wilson Valley and Guinda Projects, as required by Section 12663 of the Water Code, was made after engineering, geologic, and economic studies had determined accomplishments of a project at Wilson Valley with a storage capacity of about 300,000 acre-feet, equivalent to that of the Guinda Project. In addition to this comparison, studies were made to determine the size of reservoir at the Wilson Valley site resulting in maximum net benefits when operated under present conditions of upstream development. It was found that such a project would have a storage capacity of about 1,000,000 acre-feet.

The use of the term "economic feasibility" in the authorizing legislation was construed to refer to the relationship between costs incurred in, and the benefits which are derived from construction and operation of a water development project. This relationship is commonly termed "benefit-cost ratio", and such terminology has been used in this report.

The comparison of the alternative projects is presented under the general headings of "Engineering Feasibility" and "Economic Feasibility".

Engineering Feasibility

Studies conducted during this investigation indicated that both the Wilson Valley and Guinda Projects possess engineering feasibility. It was determined that water supplies for the projects are adequate in quantity and quality; the sites for the dams, reservoirs, and other facilities are geologically suitable; the projects can be

built with available materials and present techniques at a reasonable cost; and the proposed structures can be properly designed and be functionally sufficient. However, before a final decision is made on the project to be developed, further consideration should be given to an evaluation of alternative reservoir operation criteria, reservation of water for upstream use, and the possibility of the conjunctive development of both ground water and surface water storage.

The engineering feasibilities of the Wilson Valley and Guinda Projects were compared by relating the general features and estimated costs of the two projects.

General Project Features

A comparison of the general features of the alternative projects is presented in Table 18.

Project Costs

The capital costs of the Wilson Valley Project, with and without a reservation of storage for flood control purposes, for a range of reservoir storage cpacities up to 1,000,000 acre-feet are shown in Figure 1 of Plate 6. The capital cost of the Guinda Project with a storage capacity of 303,000 acre-feet is also shown. Corresponding annual costs are shown in Figure 2 of Plate 6.

A comparison of the estimated costs of the alternative projects is given in Table 19.

Economic Feasibility

Studies conducted during this investigation indicated that each of the alternative Wilson Valley and Guinda Projects is economically feasible. It was shown that each project would result

TABLE 18

COMPARISON OF GENERAL FEATURES OF WILSON VALLEY AND GUINDA PROJECTS

Item	Wilson Valley Project		Guinda Project
	Reservoir storage capacity of 1,000,000 acre-feet	Reservoir storage capacity of 300,000 acre-feet	Reservoir storage capacity of 303,000 acre-feet
Flood control reservation, in acre-feet	65,000	0	0
Type of dam	Earthfill	Earthfill	Earthfill
Height of dam, in feet	377	262	170
Crest length, in feet	1,340	860	8,000
Crest elevation, in feet	1,244	1,129	520
Volume of fill, in cubic yards	8,600,000	2,960,000	15,600,000
Normal pool elevation, in feet	1,238	1,123	510
Normal pool area, in acres	8,400	3,600	3,800
Dead storage, in acre-feet	3,000	3,000	3,000
Type of spillway	Side channel	Side channel	chute
Estimated average seasonal runoff, in acre-feet	372,000	372,000	456,000
Estimated firm seasonal yield, in acre-feet	252,000	142,000	158,000

TABLE 19

COMPARISON OF ESTIMATED COSTS OF WILSON VALLEY AND GUINDA PROJECTS

(Based on prices prevailing in fall of 1957)

Item	Wilson Valley 1,000,000 acre-feet		Wilson Valley 300,000 acre-feet		Guinda 303,000 acre-feet	
	Capital costs	Annual costs	Capital costs	Annual costs	Capital costs	Annual costs
Dam and appurtenances	$23,570,000		$10,760,000		$12,760,000	
Lands, easements, rights of way, and clearing	2,030,000		880,000		4,400,000	
Relocation of public utilities	5,990,000		5,990,000		905,000	
Interest and capital recovery		$1,470,000		$820,000		$841,000
Operation, maintenance, replacement, and general expense		190,000		94,000		95,000
TOTALS	$31,590,000	$1,660,000	$17,630,000	$914,000	$18,065,000	$936,000

in substantial benefits in excess of project costs. However, before a final decision is made on the project to be developed, the recreational benefits that would accrue to the projects should be evaluated in monetary terms.

In the following sections the economic feasibilities of the Wilson Valley and Guinda Projects are compared by, first, examining the accomplishments of the projects, from which the benefits would be derived, and second, by examining the benefits that would accrue from such accomplishments.

Project Accomplishments

The firm seasonal yield of the Wilson Valley Project, with and without a reservation of storage for flood control purposes, for a range of reservoir storage capacities up to 1,000,000 acre-feet, is shown in Figure 3 of Plate 6. The firm seasonal yield of the Guinda Project for a reservoir storage capacity of 303,000 acre-feet is also shown.

A comparison of the accomplishments of the alternative projects, together with the existing preproject conditions, is presented in Table 20.

Project Benefits

The benefits that would accrue from the Wilson Valley Project, with and without a reservation of storage for flood control purposes, for a range of reservoir storage capacities up to 1,000,000 acre-feet, are presented in Figure 4 of Plate 6. The benefits that would accrue from the Guinda Project with a reservoir storage capacity of 303,000 acre-feet are also shown in Figure 4.

TABLE 20

COMPARISON OF ACCOMPLISHMENTS OF WILSON VALLEY AND GUINDA PROJECTS

Item	Preproject conditions	Wilson Valley Project: Reservoir storage capacity of 1,000,000 acre-feet	Wilson Valley Project: Reservoir storage capacity of 300,000 acre-feet	Guinda Project: Reservoir storage capacity of 303,000 acre-feet
Flood control reservation, in acre-feet		65,000	0	0
Estimated firm seasonal yield, in acre-feet	105,000	252,000	142,000	158,000
Farm delivery, in acre-feet[a]	85,000	202,000	114,000	126,000
Project Area				
Land irrigated by project, in acres	25,500	84,000	48,000	52,900
Dry-farmed land in project, in acres	119,200	64,700	96,700	92,800
Native vegetation land in project, in acres	14,000	10,000	14,000	13,000
Subtotal project area, in acres	158,700	158,700	158,700	158,700
Lands from which benefits were not considered, in acres[b]	105,200	105,200	105,200	105,200
Gross area, Cache Creek Service Area, in acres	263,900	263,900	263,900	263,900
Total net farm income	$2,030,000	$7,285,000	$4,380,000	$4,793,000
Irrigation benefit at farm head gates	------	$5,255,000	$2,350,000	$2,765,000
Flood discharge with once-in-1,000 year flood, in second-feet	84,000	43,000	63,000	Not estimated
Flood discharge with once-in-100 year flood, in second-feet	60,000	15,000	33,000	Not estimated

a - Equals firm seasonal yield less 20 per cent conveyance losses.
b - See Table 2.

The excess of benefits over project costs, that would accrue from the Wilson Valley Project, with and without a reservation of storage for flood control purposes, for a range of reservoir storage capacities up to 1,000,000 acre-feet, is presented in Figure 6 of Plate 6, together with equivalent values for the Guinda Project with a reservoir storage capacity of 303,000 acre-feet. Data from the studies resulting in this curve were used in selecting the reservoir storage capacity at Wilson Valley which would provide maximum net benefits.

Benefit-Cost Ratio

The benefit-cost ratios for the Wilson Valley Project, with and without flood control reservation, for a range of reservoir storage capacities up to 1,000,000 acre-feet, and for the Guinda Project with a reservoir storage capacity of 303,000 acre-feet, are shown in Figure 5 of Plate 6.

A comparison of the estimated costs and benefits that would result from construction of one of the alternative projects is given in Table 21.

TABLE 21

COMPARISON OF ESTIMATED BENEFITS AND COSTS OF
WILSON VALLEY AND GUINDA PROJECTS

Function	Wilson Valley Project		Guinda Project
	Reservoir storage capacity of 1,000,000 acre-feet	Reservoir storage capacity of 300,000 acre-feet	Reservoir storage Capacity of 303,000 acre-feet
Annual Benefits			
Firm seasonal yield, in acre-feet	252,000	142,000	158,000
Irrigation	$ 5,255,000	$ 2,350,000	$ 2,765,000
Flood control	160,000	incidental	incidental
Recreation	high	high	moderate
Approximate total annual benefit (except recreation)	$ 5,415,000	$ 2,350,000	$ 2,765,000
Costs			
Capital	$ 31,590,000	$ 17,630,000	$ 18,065,000
Annual	$ 1,660,000	$ 914,000	$ 936,000
Benefit-Cost Ratio*	3.2:1	2.6:1	2.9:1

* (annual benefit / annual cost)

CHAPTER V. CONCLUSIONS AND RECOMMENDATIONS

This chapter contains pertinent conclusions resulting from the investigation to compare Wilson Valley and Guinda Reservoirs. Recommendations are also presented for appropriate action by those interested in the construction of a water development project on Cache Creek.

Conclusions

The engineering, geologic, and economic surveys and studies conducted during this and prior investigations, have resulted in the following conclusions:

1. The unreliability of the water supply presently available for irrigation use in the Cache Creek Service Area, and the possibilities for expansion of irrigated agriculture if adequate water can be made available, create a current need for the development of additional water conservation facilities in the Cache Creek Basin.

2. The construction of either Guinda or Wilson Valley Reservoir would provide the needed regulation for conservation. Guinda Reservoir constructed to a capacity of 303,000 acre-feet would regulate the flows of Cache Creek to provide a total firm seasonal yield of 158,000 acre-feet. Wilson Valley Reservoir constructed to a capacity of 300,000 acre-feet would provide a total firm seasonal yield of 142,000 acre-feet. Wilson Valley Reservoir would provide increasing net benefits with increases in storage to a maximum storage capacity of about 1,000,000 acre-feet. If constructed to a storage capacity of 1,000,000 acre-feet, the total firm seasonal yield from the project would be 252,000 acre-feet

3. During the winter and spring of 1958, flood conditions around Clear Lake in Lake County and the overtopping of levees along

Cache Creek in Yolo County have again emphasized the prevailing flood threat to both counties and the need for the construction of facilities to protect against flood damage.

4. Either the Wilson Valley or the Guinda Project would have a substantial beneficial effect on the control of floods in Cache Creek and on reduction of flood damage in the Cache Creek Service Area.

5. Either the Wilson Valley or the Guinda Project would have a substantial beneficial effect on the control of flood conditions in the areas adjacent to Clear Lake, provided the outlet channel from the lake were enlarged. The construction of a reservoir on the main stem of Cache Creek probably would eliminate the opposition of downstream interests in Yolo County to modification of the Bemmerly Decree, and thereby permit the enlargement of the outlet channel from Clear Lake.

6. Costs of the projects discussed in this project are estimated to be:

	Capital cost	Annual cost
Wilson Valley Project		
300,000 acre-foot storage capacity	$ 17,600,000	$ 917,000
1,000,000 acre-foot storage capacity	31,600,000	1,660,000
Guinda Project		
303,000 acre-foot storage capacity	$ 18,100,000	$ 936,000

Costs of Wilson Valley Projects were based on prices prevailing in the fall of 1957, and those of Guinda Project were based on a modification of costs as of the fall of 1954 to reflect 1957 price levels.

7. Total annual project benefits were estimated to be:

Wilson Valley Project

300,000 acre-foot storage capacity	$ 2,400,000
1,000,000 acre-foot storage capacity	5,400,000

Guinda Project

303,000 acre-foot storage capacity	$ 2,800,000

8. The further development and use of water in the basin above the Wilson Valley or Guinda Projects would deplete yields of the projects in the amount of the increase in water consumptively used upstream.

9. Either the Wilson Valley Project or the Guinda Project would provide an opportunity for the development of recreational facilities.

10. Either of the considered projects could be operated under plans whereby the fluctuation of Clear Lake would be kept to a minimum, except during critically dry periods, and all releases for downstream use would be made from the storage reservoir on the main stem of Cache Creek. Such plans of operation, however, would to some extent adversely affect reservoir recreation possibilities.

11. Both the Wilson Valley and Guinda Projects with reservoir storage capacities of about 300,000 acre-feet possess engineering and economic feasibility.

12. From an economic comparison of the alternative projects it is indicated that with a storage capacity of about 300,000 acre-feet, the Guinda Project with a benefit-cost ratio of 2.9 to 1 would have slightly greater economic feasibility than would the comparable Wilson Valley Project with a benefit-cost ratio of 2.6 to 1. The costs of Guinda Reservoir used in this comparison, however, do not reflect the increased costs of spillway construction and highway

relocation that have been determined to be necessary since the publication of the first interim report; in accordance with the legislative instructions and restrictions contained in Chapter 1950, Statutes of 1955, these increases in costs have not been evaluated.

13. The Wilson Valley Project, with reservoir storage capacities up to about 1,000,000 acre-feet, possesses engineering and economic feasibility. The project that would result in the maximum net benefits would involve a reservoir storage capacity of about 1,000,000 acre-feet; studies indicate that it would have a benefit-cost ratio of 3.2 to 1.

14. The lower Wilson Valley dam site is better from an engineering and geologic standpoint than the upper Wilson Valley site, due to better foundation conditions.

15. Although specific studies of Guinda Dam were not made during the current investigation, present geologic knowledge of foundation conditions of the site indicates that the Guinda Project, with a storage capacity of any appreciable amount in excess of 303,000 acre-feet, would not be engineeringly feasible.

16. The final choice between the alternative reservoir sites should include consideration of the adverse effects on the future economy of the State occurring from the permanent loss of the otherwise irrigable land submerged in the reservoir.

Recommendations

As a result of the engineering, geologic, and economic studies reported on herein, it is recommended:

1. That no further consideration be given to the Guinda Project for the development of the waters of Cache Creek.

2. That the Wilson Valley Project be authorized as the next water conservation project on Cache Creek, and that the reservoir storage capacity be of such amount that the project would derive the maximum net benefits.

3. That an investigation be conducted to determine the financial feasiblity of the Wilson Valley Project that would return the maximum net benefits.

4. That in developing financial feasiblity of the Wilson Valley Project, consideration be given to conjunctive operation of the project with the ground water basin in the project service area, to depletion resulting from upstream uses, to other possible water conservation developments in the Cache Creek Basin, and to a coordinated flood control operation of the reservoir with Clear Lake.

APPENDIX A

RESERVOIR YIELD STUDIES

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Seasonal Summary of Monthly Yield Study, Guinda Reservoir A-10

Summary of Reservoir Yield Study Procedures and Criteria

Presented in this appendix are seasonal summaries of monthly yield studies of Clear Lake, Wilson Valley Reservoir for 300,000 acre-foot and 1,000,000 acre-foot capacity, and Guinda Reservoir for 303,000 acre-foot storage capacity. The objective of these studies was to determine the water supply that would be available at the Moore and Capay Diversion Dams under preproject and project conditions.

The general procedure included:

1. Compilation and analysis of all pertinent hydrologic data.
2. A monthly yield study of Clear Lake to determine the theoretical inflow to the lake for the average period 1911-12 to 1955-56 with the present level of water use throughout that period, assuming an enlarged outlet channel of 8,500 second-foot capacity, and using the storage and release criteria established by the Gopcevic Decree.
3. A monthly yield study of Clear Lake using the above-estimated theoretical inflow to the lake to determine theoretical releases and spills from the lake for the mean period under the criteria stated in the above step. A summary of this study is presented in this appendix.
4. Monthly yield studies of the previously proposed Guinda Reservoir and four sizes of reservoirs at Wilson Valley using the theoretical releases and spills from Clear Lake, and estimated inflow from the remaining tributary area to determine the firm yield available to the project service area at the diversion point. Seasonal summaries of studies for reservoirs at Wilson Valley with storage capacities of 300,000

and 1,000,000 acre-feet and for Guinda Reservoir with a storage capacity of 300,000 acre-feet are presented in this appendix.

Discussion of the various items included in the reservoir yield studies is presented below.

Clear Lake Yield Study

1. Inflow to Clear Lake represents the theoretical inflow that would occur with present level of water use development imposed upon historical water supply data for Clear Lake. This was determined in a yield study in which the lake was operated within the limits of the Gopcevic Decree. It was also assumed that the lake outlet was enlarged to 8,500 second-foot capacity.
2. Clear Lake storage on April 1, as shown, was used to establish theoretical releases as required by the Gopcevic Decree and estimated inflow. Elevations shown refer to the Rumsey gage.
3. Unit water surface evaporation was based upon records of evaporation at East Park Reservoir on Stony Creek.
4. The area of Clear Lake and the storage capacity at various water stages were based upon data obtained from the United States Bureau of Reclamation.
5. The seasonal release from Clear Lake was based on criteria developed from the relationship between historical diversions at Moore and Capay Dams and the April 1 water stage of Clear Lake. The seasonal release thus determined was proportioned on a monthly schedule approximating present practice

and altered to reflect estimated downstream losses or gains to produce the required monthly release at Clear Lake.

6. Spill from Clear Lake represents water discharged from the lake to prevent the water stage from exceeding elevation 7.56 on the Rumsey gage.

Wilson Valley Reservoir Yield Study

1. Inflow to Wilson Valley Reservoir is comprised of spills and releases from Clear Lake as determined from the above yield study, and inflow from the area tributary to Cache Creek below Clear Lake Dam including the North Fork of Cache Creek.
2. Unit water surface evaporation was based upon records of evaporation at East Park Reservoir on Stony Creek.
3. Areas of the reservoir and storage capacities at various stages were determined from reservoir topographic maps prepared by the United States Bureau of Reclamation. These were supplemented by recent United States Geological Survey quadrangles.
4. Releases from the reservoir were made in amounts that would provide a firm seasonal yield on a monthly irrigation schedule at the Moore Ditch and Capay Dam diversion points.
5. Spill from Wilson Valley Reservoir represents discharge over the spillway or releases through the flood control outlet to maintain the reservoir storage within operating limits.

Guinda Reservoir Yield Study

1. All yield study procedures and criteria for Guinda Reservoir were the same as those for Wilson Valley.
2. Additional runoff occurring between the two dam sites was added to the inflow to Wilson Valley to determine the inflow to Guinda Reservoir.
3. The area of Guinda Reservoir and the storage capacity at various water stages were based upon data prepared by the former Division of Water Resources.

SEASONAL SUMMARY OF MONTHLY YIELD STUDY

CLEAR LAKE

(In acre-feet)

Active storage capacity: 314,000 acre-feet

Season	Inflow to Clear Lake*	Storage, October 1	Evaporation	Gage height: on April 1, in feet on Rumsey gage	Spill	Release from Clear Lake	Yield at points of diversion, preproject conditions
1911-12	209,700	354,900	207,600	3.21	9,700	3,700	1,300
13	297,000	343,600	216,500	5.08	20,700	77,800	88,000
14	873,400	325,600	227,100	7.56	465,700	151,600	164,500
15	762,300	354,600	200,900	7.56	411,900	145,600	164,500
1915-16	492,900	358,500	219,100	7.56	141,200	151,500	164,500
17	305,000	339,600	209,000	5.82	18,400	117,600	123,500
18	205,700	299,600	216,100	2.15	2,600	0	0
19	366,200	286,600	212,300	5.80	11,400	113,600	122,800
20	118,500	315,500	202,200	0.58	21,500	1,200	0
1920-21	633,700	209,100	201,400	7.56	120,700	152,600	164,500
22	318,400	368,100	218,400	6.15	13,700	127,700	139,000
23	339,000	326,700	224,400	4.87	32,000	72,000	79,000
24	140,100	337,300	238,500	1.68	0	100	0
25	515,100	238,800	184,100	6.25	96,200	122,600	143,500
1925-26	335,600	351,000	180,100	5.66	82,400	107,600	116,000
27	771,700	316,500	194,100	7.56	382,400	152,000	164,500
28	429,000	359,700	204,300	7.56	80,800	154,200	164,500
29	167,900	349,400	206,500	2.77	1,400	1,400	0
30	363,500	308,000	197,900	6.05	17,500	123,100	134,000
1930-31	134,400	333,000	224,000	1.42	0	1,500	0
32	286,300	241,900	207,200	3.11	3,800	0	0
33	194,300	317,200	208,900	2.82	3,900	0	0
34	254,200	298,700	206,300	3.78	4,300	22,200	28,300
35	422,900	320,100	189,300	7.12	73,400	153,900	164,500
1935-36	425,900	326,400	195,600	7.56	37,600	152,700	164,500
37	314,000	366,200	199,400	6.46	17,500	144,500	153,300
38	789,800	318,800	186,300	7.56	408,500	153,400	164,500
39	152,500	360,400	203,100	3.22	0	6,400	2,000
40	598,900	303,400	193,600	7.56	204,800	151,800	164,500
1940-41	889,700	352,100	188,600	7.56	543,700	150,600	164,500
42	749,200	358,900	192,200	7.56	389,000	148,300	164,500
43	523,700	378,600	200,500	7.56	175,600	157,800	164,500
44	229,600	368,400	185,300	5.10	7,900	82,200	90,000
45	306,800	322,600	189,600	5.86	11,700	123,200	125,700
1945-46	411,700	304,900	192,400	7.56	37,900	155,700	164,500
47	209,800	330,600	197,400	3.64	11,800	21,300	21,500
48	267,100	309,900	157,500	2.18	129,500	300	0
49	361,400	289,700	254,600	5.22	4,400	89,500	90,000
50	360,300	302,600	293,800	4.22	21,300	43,900	48,300
1950-51	594,600	303,900	271,700	7.56	129,100	141,800	164,500
52	723,000	355,900	266,800	7.56	309,800	147,100	164,500
53	590,500	355,200	263,800	7.56	174,800	143,500	164,500
54.	460,400	363,600	254,600	7.56	67,900	150,100	164,500
55	248,400	351,400	216,000	4.05	36,400	32,600	41,000
1955-56	867,400	314,800	217,100	7.56	462,500	147,700	164,500
Average	422,500	326,500	211,500	5.56	115,500	95,500	103,800

* Estimated inflow to Clear Lake, assuming present conditions of water use development prevailed throughout the study period.

SEASONAL SUMMARY OF MONTHLY YIELD STUDY

WILSON VALLEY RESERVOIR
WITH 300,000 ACRE-FOOT STORAGE CAPACITY

(In acre-feet)

Seasonal yield: 142,000 acre-feet — Without flood control storage reservation

Season	Inflow to Wilson Valley Reservoir: Cache Creek below Clear Lake*	Inflow: Spill from Clear Lake	Inflow: Irrigation release from Clear Lake	Inflow: Total	Storage, October 1	Evaporation	Spill	Release from reservoir	Yield at point of diversion
1911-12	35,700	9,700	3,700	49,100	300,000	8,000	31,500	139,700	142,000
13	60,300	20,700	77,800	158,800	169,900	7,000	0	132,500	142,000
14	423,600	465,700	151,600	1,040,900	189,200	10,700	772,400	147,000	142,000
15	334,300	411,900	145,600	891,800	300,000	9,500	715,600	166,700	142,000
1915-16	321,500	141,200	151,500	614,200	300,000	10,500	454,700	149,000	142,000
17	127,000	18,400	117,600	263,000	300,000	9,900	134,500	144,600	142,000
18	48,700	2,600	0	51,300	274,000	9,400	14,400	140,600	142,000
19	142,900	11,400	113,600	267,900	160,900	9,600	4,900	141,200	142,000
20	29,500	21,500	1,200	52,200	273,100	9,000	14,800	142,600	142,000
1920-21	222,400	120,700	152,600	495,700	158,900	9,700	198,200	146,700	142,000
22	103,700	13,700	127,700	245,100	300,000	11,100	107,300	138,600	142,000
23	125,300	32,000	72,000	229,300	288,100	9,300	134,100	141,800	142,000
24	26,300	0	100	26,400	232,200	10,900	0	140,800	142,000
25	154,100	96,200	122,600	372,900	107,700	6,500	43,100	136,000	142,000
1925-26	154,300	82,400	107,600	344,300	295,000	8,300	201,300	161,300	142,000
27	242,000	382,400	152,000	776,400	268,400	8,900	586,000	149,900	142,000
28	139,400	80,800	154,200	374,400	300,000	10,200	219,400	139,800	142,000
29	37,900	1,400	1,400	40,700	300,000	9,700	28,200	143,100	142,000
30	148,300	17,500	123,100	288,900	159,700	10,200	11,500	143,300	142,000
1930-31	16,600	0	1,500	18,100	283,600	9,000	0	134,100	142,000
32	87,500	3,800	0	91,300	158,600	7,500	0	138,800	142,000
33	43,000	3,900	0	46,900	102,900	4,700	0	142,300	142,000
34	53,500	4,300	22,200	80,000	2,800	2,600	0	65,400	71,000
35	141,300	73,400	153,900	368,600	14,800	7,500	0	146,300	142,000
1935-36	173,500	37,600	152,700	363,800	229,600	8,900	56,800	147,700	142,000
37	98,600	17,500	144,500	260,600	300,000	9,300	102,700	148,700	142,000
38	459,000	408,500	153,400	1,020,900	299,800	8,300	844,700	167,700	142,000
39	21,600	0	6,400	28,000	300,000	8,900	18,800	138,500	142,000
40	289,100	204,800	151,800	645,700	161,800	8,900	337,500	161,100	142,000
1940-41	466,300	543,700	150,600	1,160,600	300,000	7,400	974,900	178,300	142,000
42	322,300	389,000	148,300	859,600	300,000	7,800	698,100	153,700	142,000
43	169,100	175,600	157,800	502,500	300,000	8,500	343,100	150,900	142,000
44	68,700	7,900	82,200	158,800	300,000	10,000	65,300	141,500	142,000
45	96,700	11,700	123,200	231,600	242,000	9,100	38,700	148,900	142,000
1945-46	156,200	37,900	155,700	349,800	276,900	9,000	172,300	145,400	142,000
47	42,000	11,800	21,300	75,100	300,000	8,800	47,200	140,700	142,000
48	72,500	129,500	300	202,300	178,400	5,100	49,800	135,900	142,000
49	92,900	4,400	89,500	186,800	189,800	11,600	0	149,100	142,000
50	76,700	21,300	43,900	141,900	215,900	13,600	400	142,300	142,000
1950-51	208,800	129,100	141,800	479,700	201,500	12,800	230,500	137,900	142,000
52	317,900	309,800	147,100	774,800	300,000	12,800	626,500	135,600	142,000
53	224,300	174,800	143,500	542,600	300,000	12,800	388,700	141,100	142,000
54	147,500	67,900	150,100	365,500	300,000	12,000	216,400	137,100	142,000
55	56,400	36,400	32,600	125,400	300,000	9,700	70,200	141,800	142,000
1955-56	441,800	462,500	147,700	1,052,000	203,700	10,600	806,300	138,800	142,000
Average	160,500	115,500	95,500	371,500	238,600	9,200	216,900	143,500	140,400

* Includes the runoff from the tributary area between Clear Lake Dam and the Wilson Valley dam site and from North Fork Cache Creek.

SEASONAL SUMMARY OF MONTHLY YIELD STUDY

WILSON VALLEY RESERVOIR
WITH 1,000,000 ACRE-FOOT STORAGE CAPACITY

(In acre-feet)

Seasonal yield: 252,000 acre-feet

Flood control storage reservation of 65,000 acre-feet from November 1 to April 1

Season	Inflow to Wilson Valley Reservoir: Cache Creek below Clear Lake*	Spill from Clear Lake	Irrigation release from Clear Lake	Total	Storage, October 1	Evaporation	Spill	Release from reservoir	Yield at point of diversion
1911-12	35,700	9,700	3,700	49,100	853,300	17,400	0	249,600	252,000
13	60,300	20,700	77,800	158,800	635,400	18,400	0	241,300	252,000
14	423,600	465,700	151,600	1,040,900	534,400	23,600	429,300	257,000	252,000
15	334,300	411,900	145,600	891,800	865,300	21,700	560,200	276,700	252,000
1915-16	321,500	141,200	151,500	614,200	909,000	23,700	399,600	259,000	252,000
17	127,000	18,400	117,600	263,000	840,900	22,800	12,700	254,600	252,000
18	48,700	2,600	0	51,300	813,900	21,000	0	250,600	252,000
19	142,900	11,400	113,600	267,900	593,700	19,000	0	251,200	252,000
20	29,500	21,500	1,200	52,200	591,700	16,100	0	252,600	252,000
1920-21	222,400	120,700	152,600	495,700	375,200	16,200	0	256,600	252,000
22	103,700	13,700	127,700	245,100	598,000	19,600	0	248,600	252,000
23	125,300	32,000	72,000	229,300	574,900	16,800	0	251,800	252,000
24	26,300	0	100	26,400	535,600	18,100	0	250,800	252,000
25	154,100	96,200	122,600	372,900	293,100	9,400	0	244,200	252,000
1925-26	154,300	82,400	107,600	344,300	412,300	13,900	0	271,300	252,000
27	242,000	382,400	152,000	776,400	471,400	20,200	69,000	259,900	252,000
28	139,400	80,800	154,200	374,400	898,700	23,100	104,000	249,800	252,000
29	37,900	1,400	1,400	40,700	896,200	22,600	0	253,100	252,000
30	148,300	17,500	123,100	288,900	661,200	20,300	0	253,300	252,000
1930-31	16,600	0	1,500	18,100	676,500	16,600	0	244,100	252,000
32	87,500	3,800	0	91,300	433,900	13,300	0	248,800	252,000
33	43,000	3,900	0	46,900	263,100	8,500	0	252,300	252,000
34	53,500	4,300	22,200	79,900	49,200	3,800	0	118,600	126,000
35	141,300	73,400	153,900	368,600	6,700	5,500	0	257,200	252,000
1935-36	173,500	37,600	152,700	363,800	112,600	7,800	0	257,800	252,000
37	98,600	17,500	144,500	260,600	210,800	9,300	0	258,700	252,000
38	459,000	408,500	153,400	1,020,900	203,400	17,300	70,900	277,700	252,000
39	21,600	0	6,400	28,000	858,400	19,800	0	248,500	252,000
40	289,100	204,800	151,800	645,700	613,500	20,200	86,200	271,100	252,000
1940-41	466,300	543,700	150,600	1,160,600	881,700	17,900	831,700	288,300	252,000
42	322,300	389,000	148,300	859,600	905,800	19,300	564,700	263,700	252,000
43	169,100	175,600	157,800	502,500	917,600	21,300	280,500	260,900	252,000
44	68,700	7,900	82,200	158,800	857,300	17,900	0	251,500	252,000
45	96,700	11,700	123,200	231,600	746,700	18,300	0	258,900	252,000
1945-46	156,200	37,900	155,700	349,800	701,100	18,700	0	255,500	252,000
47	42,000	11,800	21,300	75,100	776,600	18,800	0	251,600	252,000
48	72,500	129,500	300	202,300	581,300	12,000	0	242,400	252,000
49	92,900	4,400	89,500	186,800	529,000	20,400	0	259,100	252,000
50	76,700	21,300	43,900	141,900	436,300	20,100	0	252,300	252,000
1950-51	208,800	129,100	141,800	479,700	305,800	20,400	0	247,900	252,000
52	317,900	309,800	147,100	774,700	517,200	27,000	161,000	244,800	252,000
53	224,300	174,800	143,500	542,700	859,100	28,200	262,200	251,100	252,000
54	147,500	67,900	150,100	365,500	860,300	27,400	62,800	242,800	252,000
55	56,400	36,400	32,600	125,400	892,800	22,800	0	251,800	252,000
1955-56	441,800	462,500	147,700	1,052,000	743,700	23,500	670,100	248,800	252,000
Average	160,500	115,500	95,500	371,500	606,500	18,200	101,400	252,000	249,200

* Includes the runoff from the tributary area between Clear Lake Dam and the Wilson Valley dam site and from North Fork Cache Creek.

SEASONAL SUMMARY OF MONTHLY YIELD STUDY

GUINDA RESERVOIR

(In acre-feet)

Storage capacity: 303,000 acre-feet
Seasonal yield: 158,000 acre-feet

Without flood control storage reservation

Season	Inflow to Guinda Reservoir: Cache Creek below Clear Lake*	Inflow to Guinda Reservoir: Spill from Clear Lake	Inflow to Guinda Reservoir: Irrigation release from Clear Lake	Inflow to Guinda Reservoir: Total	Storage October 1	Evaporation	Spill	Release from reservoir	Yield at point of diversion
1911-12	56,900	9,700	3,700	70,300	296,800	9,300	41,500	162,300	158,000
13	97,800	20,700	77,800	196,300	154,000	10,400	0	153,400	158,000
14	630,000	465,700	151,600	1,247,300	186,500	11,700	949,500	175,900	158,000
15	499,400	411,900	145,600	1,056,900	296,700	10,300	837,400	209,200	158,000
1915-16	479,700	141,200	151,500	772,400	296,700	11,600	583,700	176,500	158,000
17	194,000	18,400	117,600	330,000	297,300	11,100	188,100	170,000	158,000
18	77,200	2,600	0	79,800	258,100	10,900	19,400	163,300	158,000
19	217,900	11,400	113,600	342,900	144,300	11,100	55,300	164,100	158,000
20	47,200	21,500	1,200	69,900	257,000	10,400	5,400	168,700	158,000
1920-21	334,700	120,700	152,600	608,000	142,400	10,200	266,200	183,700	158,000
22	160,200	13,700	127,700	301,600	290,400	11,900	145,100	165,900	158,000
23	191,900	32,000	72,000	295,900	269,200	9,300	169,000	168,800	158,000
24	42,400	0	100	42,500	218,000	12,300	0	161,000	158,000
25	234,100	96,200	122,600	452,900	87,200	7,200	83,200	167,200	158,000
1925-26	234,000	82,400	107,600	424,000	282,500	9,600	236,500	208,200	158,000
27	362,400	382,400	152,000	896,800	252,200	9,900	648,000	198,800	158,000
28	213,600	80,800	154,200	448,600	292,400	10,900	261,900	171,800	158,000
29	60,400	1,400	1,400	63,200	296,400	11,000	41,800	161,200	158,000
30	226,500	17,500	123,100	367,100	145,600	10,300	66,800	167,000	158,000
1930-31	26,800	0	1,500	28,300	268,600	9,800	0	153,400	158,000
32	136,000	3,800	0	139,800	133,700	9,600	0	159,000	158,000
33	68,300	3,900	0	72,200	140,900	7,600	0	164,900	158,000
34	84,600	4,300	22,200	111,100	4,600	5,600	0	76,100	79,000
35	211,200	73,400	153,900	438,500	34,100	8,800	0	182,000	158,000
1935-36	264,900	37,600	152,700	455,200	281,900	9,500	252,800	177,100	158,000
37	147,400	17,500	144,500	309,400	297,800	10,900	134,500	174,800	158,000
38	688,600	408,500	153,400	1,250,500	287,000	8,800	1,026,100	204,600	158,000
39	34,900	0	6,400	41,300	298,000	9,900	27,900	156,600	158,000
40	427,300	204,800	151,800	783,900	144,900	9,700	424,200	197,200	158,000
1940-41	690,900	543,700	150,600	1,385,200	297,800	8,400	1,138,900	239,000	158,000
42	473,500	389,000	148,300	1,010,800	298,100	9,000	802,200	200,200	158,000
43	259,900	175,600	157,800	593,300	297,400	10,400	405,300	177,900	158,000
44	170,100	7,900	82,200	260,200	297,000	9,100	92,700	169,000	158,000
45	150,600	11,700	123,200	285,500	228,400	10,000	69,400	173,600	158,000
1945-46	244,200	37,900	155,700	437,800	260,900	9,700	222,500	169,000	158,000
47	67,300	11,800	21,300	100,400	297,400	10,000	63,000	162,500	158,000
48	116,900	129,500	300	246,700	162,300	6,900	47,200	178,700	158,000
49	145,700	4,400	89,500	239,600	176,000	13,700	4,800	172,600	158,000
50	120,400	21,300	43,900	185,600	224,400	15,700	42,300	167,300	158,000
1950-51	319,000	129,100	141,800	589,900	184,800	13,700	301,100	165,300	158,000
52	483,100	309,800	147,100	940,000	294,600	13,600	762,300	164,100	158,000
53	342,500	174,800	143,500	660,800	294,600	13,300	475,100	170,700	158,000
54	227,300	67,900	150,100	445,300	296,400	13,100	267,000	175,300	158,000
55	89,200	36,400	32,600	158,200	286,300	10,900	76,600	169,500	158,000
1955-56	655,500	462,500	147,700	1,265,700	187,600	11,500	981,300	163,700	158,000
Average	244,600	115,500	95,500	455,600	221,200	10,400	271,500	172,500	156,200

* Includes the runoff from the tributary area between Clear Lake Dam and the Guinda dam site and from North Fork Cache Creek.

APPENDIX B

COST ESTIMATES

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Estimated Cost of Wilson Valley Dam and Reservoir With 300,000 Acre-Foot Storage Capacity B-3

Estimated Cost of Wilson Valley Dam and Reservoir With 1,000,000 Acre-Foot Storage Capacity B-5

ESTIMATED COST OF WILSON VALLEY DAM AND RESERVOIR
WITH 300,000 ACRE-FOOT STORAGE CAPACITY

(Based on prices prevailing in June, 1957)

Elevation of crest of dam:
1,129 feet, U.S.G.S. datum
Elevation of crest of spillway:
1,108 feet
Height of spillway crest,
above stream bed: 241 feet

Capacity of reservoir to crest of
spillway: 300,000 acre-feet
Capacity of spillway with 6-foot
freeboard: 63,000 second-feet

Item	Quantity	Unit price, in dollars	Total cost, in dollars	
Dam				
Diversion and care of stream		lump sum	500,000	
Stripping and preparation of foundation	423,400 cu. yd.	1.75	741,000	
Grouting				
Drilling	5,200 lin. ft.	5.00	26,000	
Pressure grout	7,800 cu. ft.	4.00	31,200	
Embankment				
Pervious (new excavation)	1,612,200 cu. yd.	1.25	2,015,200	
Pervious (salvage)	593,000 cu. yd.	0.20	118,600	
Impervious	751,200 cu. yd.	0.80	601,000	
Riprap	2,960 cu. yd.	6.40	18,900	4,051,900
Spillway				
Excavation	625,000 cu. yd.	2.25	1,406,200	
Concrete				
Weir and lining	4,194 cu. yd.	50.00	209,700	
Retaining walls	381 cu. yd.	80.00	30,500	
Structural	880 cu. yd.	90.00	79,200	
Reinforcing steel	1,023,900 lbs.	0.17	174,100	
Drains	4,600 lin. ft.	5.00	23,000	
Grouting		lump sum	6,600	1,929,300
Outlet Works				
Tunnel	1,250 lin. ft.	1,260.00	1,575,000	
Excavation				
Inlet portal	66,100 cu. yd.	1.75	115,700	
Outlet portal and stilling basin	52,700 cu. yd.	1.75	92,200	
Concrete				
Inlet structure				
Lining	150 cu. yd.	80.00	12,000	
Structural	22 cu. yd.	90.00	2,000	
Outlet structure				
Foundation	29 cu. yd.	50.00	1,400	
Structural	95 cu. yd.	90.00	8,600	
Stilling basin				
Lining	220 cu. yd.	50.00	11,000	
Retaining walls	133 cu. yd.	80.00	10,600	
Structural	27 cu. yd.	90.00	2,400	
Gate chamber plug				
Semi-structural	850 cu. yd.	80.00	68,000	

ESTIMATED COST OF WILSON VALLEY DAM AND RESERVOIR
WITH 300,000 ACRE-FOOT STORAGE CAPACITY (continued)

Item	Quantity	Unit price, in dollars	Total cost, in dollars	
Outlet Works (continued)				
Reinforcing steel	113,000 lbs.	0.17	19,200	
Steel pipe 2 each, 60" dia., 1/4" plate, 840' long	286,000 lbs.	0.30	85,800	
Pipe supports		lump sum	10,300	
Miscellaneous metal (trashrack, stop logs, etc.)	300,000 lbs.	0.30	90,000	
High-pressure gate valves, 4' x 4'	2 each	34,000	68,000	
Howell-Bunger valves, 54" diameter	2 each	54,000	108,000	
Riprap	150 cu. yd.	6.40	1,000	
Air vent, 12" diameter	210 lin. ft.	50.00	10,500	2,291,700
Reservoir				
Land and improvements		lump sum	273,800	
State highway relocation		lump sum	4,610,000	
Clearing	4,000 acres	100.00	400,000	5,283,800
Subtotal				13,556,700
Engineering and administration, 10 per cent				1,355,700
Contingencies, 15 per cent				2,033,500
Interest during construction, 4 per cent for 1/2 of 2-year period				677,800
TOTAL CAPITAL COST				17,623,700
ANNUAL COST				
Interest				704,900
Repayment				115,400
Replacement				12,300
Operation and maintenance				24,500
General expense				56,400
TOTAL ANNUAL COST				913,500

ESTIMATED COST OF WILSON VALLEY DAM AND RESERVOIR
WITH 1,000,000 ACRE-FOOT STORAGE CAPACITY

(Based on prices prevailing in June, 1957)

Elevation of crest of dam:
1,244 feet, U.S.G.S. datum
Elevation of crest of spillway:
1,228 feet
Height of spillway crest,
above stream bed: 361 feet

Capacity of reservoir to crest of
spillway: 1,000,000 acre-feet
Capacity of spillway with 6-foot
freeboard: 45,000 second-feet

Item	Quantity	Unit price, in dollars	Total cost, in dollars	
Dam				
Diversion and care of stream		lump sum	600,000	
Stripping and preparation of foundation	886,050 cu. yd.	1.75	1,550,600	
Grouting				
Drilling	11,400 lin. ft.	5.00	57,000	
Pressure grout	17,100 cu. ft.	4.00	68,400	
Embankment				
Pervious (new excavation)	5,193,000 cu. yd.	1.25	6,491,200	
Pervious (salvage)	1,468,400 cu. yd.	0.20	293,700	
Impervious	1,934,710 cu. yd.	0.80	1,547,800	
Riprap	4,220 cu. yd.	6.40	27,000	10,635,700
Spillway				
Excavation	1,378,000 cu. yd.	2.25	3,100,500	
Concrete				
Weir and lining	5,647 cu. yd.	50.00	282,400	
Retaining walls	1,322 cu. yd.	80.00	105,800	
Structural	910 cu. yd.	90.00	81,900	
Reinforcing steel	1,126,100 lbs.	0.17	191,400	
Drains	6,500 lin. ft.	5.00	32,500	
Grouting		lump sum	10,600	
Radial gate, 40" x 30"	1 each	lump sum	49,500	
Radial gate hoist	1 each	lump sum	21,300	3,875,900
Outlet Works				
Tunnel	1,679 lin. ft.	1,260.00	2,115,500	
Excavation				
Inlet portal	80,700 cu. yd.	1.75	141,200	
Outlet portal and stilling basin	55,000 cu. yd.	1.75	96,200	
Concrete				
Inlet structure				
Lining	180 cu. yd.	80.00	14,400	
Structural	120 cu. yd.	90.00	10,800	
Outlet structure				
Foundation	33 cu. yd.	50.00	1,700	
Structural	120 cu. yd.	90.00	10,800	
Stilling basin				
Lining	360 cu. yd.	50.00	18,000	
Retaining walls	184 cu. yd.	80.00	14,700	
Structural	61 cu. yd.	90.00	5,500	

ESTIMATED COST OF WILSON VALLEY DAM AND RESERVOIR
WITH 1,000,000 ACRE-FOOT STORAGE CAPACITY (continued)

Item	Quantity	Unit price, in dollars	Total cost, in dollars	
Outlet Works (continued)				
Concrete (continued)				
Gate chamber plug				
Semi-structural	830 cu. yd.	80.00	66,400	
Reinforcing steel	187,200 lbs.	0.17	31,800	
Steel pipe				
2 each, 72" dia., 7/16" plate, 1,280' long	915,000 lbs.	0.30	274,500	
Pipe supports		lump sum	32,900	
Miscellaneous metal (trashrack, stop logs, etc.)	500,000 lbs.	0.30	150,000	
High-pressure gate valves, 4-1/2' x 4-1/2'	2 each	61,600	123,200	
Howell-Bunger valves, 66" diameter	2 each	72,000	144,000	
Riprap	350 cu. yd.	6.40	2,200	
Air vent, 12" diameter	424 lin. ft.	50.00	21,200	3,275,000
Reservoir				
Land and improvements		lump sum	546,700	
Clearing	9,000 acres	100.00	900,000	
State highway relocation		lump sum	4,610,000	6,056,700
Subtotal				23,843,300
Engineering and administration, 10 per cent				2,384,300
Contingencies, 15 per cent				3,576,500
Interest during construction, 4 per cent for 1/2 of 3-year period				1,788,200
TOTAL CAPITAL COST				31,592,300
ANNUAL COST				
Interest				1,263,700
Repayment				206,900
Replacement				22,100
Operation and maintenance				67,000
General expense				101,100
TOTAL ANNUAL COST				1,660,800

APPENDIX C

GEOLOGY

OF

WILSON VALLEY AND GUINDA DAM SITES

ON

CACHE CREEK

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PLATES

Plates C1 through C6 are bound at end of this appendix.

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C1	Areal Geology of Upper and Lower Wilson Valley Dam Sites
C2	Geologic Sections of Upper and Lower Wilson Valley Dam Sites
C3	Possible Sources of Construction Materials, Wilson Valley Dam Site
C4	Isoseismal Map for Earthquake of May 7, 1955
C5	Geology of Reservoir Area and Location of Soil Samples, Guinda Dam Site
C6	Surface and Subsurface Geology and Location of Test Holes, Guinda Dam Site

CHAPTER I. INTRODUCTION

Preliminary geologic explorations have been conducted by the Department of Water Resources for the purpose of investigating two alternative reservoir sites on Cache Creek. Two separate exploration programs were undertaken -- an investigation of Guinda dam site located in the vicinity of Guinda, Yolo County, and an investigation of two Wilson Valley dam sites located downstream from the confluence of Cache Creek and North Fork Cache Creek.

During the spring of 1953, preliminary geologic exploration was undertaken in the vicinity of the town of Guinda, Yolo County, for the purpose of locating a suitable site for the construction of an earthfill dam. A dam at this site would control the runoff from approximately 992 square miles of drainage area.

During the early winter of 1955 and the spring and early winter of 1956, a program of geologic exploration was conducted in the Wilson Valley area on Cache Creek. The purpose of this exploration was to determine the most favorable location for construction of an earthfill dam. A dam at the Wilson Valley site would control the runoff from an area of approximately 793 square miles.

The location of the dam sites is shown on the locality map on Plate C1, "Areal Geology of Upper and Lower Wilson Valley Dam Sites".

General structural features of the Wilson Valley area covered by this report include large complex folds and steeply dipping faults, some of which are several miles in length. These features trend northwestwardly.

The Guinda dam site is located in an area of younger and less deformed rocks. Capay Valley is a broad, elongated, synclinal

valley bounded on the east by an asymmetric anticline and on the west by an easterly dipping homoclinal structure. Minor folds and two faults, one of which is a thrust fault, are also present.

Geologic formations through which Cache Creek flows are primarily sedimentary and range in age from Recent to Upper Jurassic. These include the Tehama and Cache formations of Plio-Pleistocene age, the Capay formation of Eocene age, the Chico formation of Cretaceous age, and the Knoxville group of Upper Jurassic age. The area investigated is in the geomorphic stage of early maturity. The general topography near the Wilson Valley sites consists of irregular hilly areas with a complex stream pattern, while the Guinda site is located in a broad flat valley surrounded by low hills.

Prior Investigations and Reports

The following reports were utilized during the preparation of this report:

1. Anderson, C. A. and Russell, R. D., "Tertiary Formations of Northern Sacramento Valley, California". California State Department of Natural Resources, Division of Mines, Journal of Mines and Geology. Volume 35. 1939.

2. Borglin, Edgar K., "The Geology of a Part of the Morgan Valley Quadrangle", University of California, Master's Thesis. 1949.

3. Brice, James C., "Geology of Lower Lake Quadrangle, California". California State Department of Natural Resources, Division of Mines. Bulletin No. 166. April, 1953.

4. Crook, T. H. and Kirby, J. M., "Capay Formation". Geological Society of America Proceedings, 1934-1935.

5. Kirby, J. M., "Upper Cretaceous Stratigraphy of West Side of Sacramento Valley South of Willows, Glenn County, California". Bulletin American Association of Petroleum Geologists. Volume 27. No. 3. 1943.

6. Kirby, J. M., "Rumsey Hills Area". California State Department of Natural Resources, Division of Mines. Bulletin No. 118. March, 1943.

7. Lawton, John E. "Geology of the North Half of Morgan Valley and South Half of Wilbur Springs Quadrangle". Stanford University, Doctor of Philosophy Thesis. 1954. (Geologic map and cross sections only utilized in this report.)

8. Northern California Geological Society, Pacific Section American Association of Petroleum Geologists. "Spring Field Trip, May 7-8,1954, Capay Valley to Wilbur Springs, West Side Sacramento Valley, California". May 7, 1954.

9. U. S. Department of Commerce - U. S. Coast and Geodetic Survey, "Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region", (annual and biannual compilations) (1940 to present).

10. Wood, H. O. and Heck, N. H. "Earthquake History of the United States, Part II - Stronger Earthquakes of California and Western Nevada". United States Department of Commerce, Coast and Geodetic Society. (1769 through 1940).

Exploration Program

Limited programs of geologic exploration were conducted at the Guinda and Wilson Valley dam sites. In general, the programs comprised surface geologic mapping, subsurface explorations along the axes of the dam sites and in the spillway areas, and collection of soil samples for laboratory testing. Particular attention was given to the condition of the rock, including degree of weathering, patterns of jointing, and the nature and extent of shear zones.

Wilson Valley Dam Sites

Two axes, designated the upper and the lower, were explored by the Department of Water Resources in 1955 and 1956. The upper site is located at a narrow constriction in the canyon of Cache Creek immediately below Wilson Valley. The lower site is located about 1 mile farther downstream and is immediately below a right angle bend where the stream channel changes from a southeast to a southwest direction. Dam site locations are shown on Plate C1.

The exploration program consisted of the following: surface geologic mapping of the upper and lower sites, exploratory drilling along the dam axis and spillway area at the upper site, exploratory drilling near the dam axis at the lower site, dozing cuts and trenches in the spillway area at the lower site, and collecting soil samples from potential borrow areas for laboratory tests.

Three test holes were drilled along the dam axis of the upper site. Total footage in the three holes amounted to 309.7 feet. Two of these holes were located in the channel and were drilled at angles so as to intersect at about 60 feet beneath mid-channel. These holes were used to determine the depth of channel sands and gravels, the presence of any faults, and the character of the foundation rock below the channel. The third hole was drilled through landslide and colluvial material into relatively fresh Knoxville sediments in order to determine the depth of stripping.

Four test holes, numbered WV1L, WV2L, WV3L, and WV4L, were drilled into the left abutment area and along the proposed dam axis at the upper site. The total footage of these holes amounted to 282.0 feet. These holes were located to determine the thickness and character of the Cache formation.

At the lower site six test holes were drilled. Two of these were located in the channel to detect the presence of any faults, to determine the character and thickness of the stream deposits, and to determine the character of the foundation rock. One hole was drilled in the left abutment to determine the character of the upper portion of the abutment. This information was required primarily to ascertain stripping estimates. On the right abutment three holes were drilled through the fractured and broken rock of

the abutment into relatively fresh material. Five exploratory trenches and angle cuts were made by a D-8 tractor and bulldozer in the upstream approach and ridge crest of the spillway area. These cuts and trenches were examined to determine the lithologic character of the material, to detect the presence of any faults in the spillway area, to determine resistance to stripping, and to ascertain the stability of various slopes. Detailed logs are in the files of the Department of Water Resources. Cores obtained from the drilling program are also available for inspection.

Location of test holes, exploratory drifts, and bulldozer cuts; the location of cross sections along the axes; and detailed distribution of geologic formations present in the dam site areas are shown on Plate C1. Geologic cross sections A-A' and B-B' are shown on Plate C2, entitled "Geologic Sections of Upper and Lower Wilson Valley Dam Sites, Cache Creek".

Guinda Dam Site

The exploration program included surface geologic mapping in Capay Valley from Guinda to the north end of the valley, a seismic survey along the selected dam site axis, exploratory drilling along the axis of the dam and in the abutments and spillway area, and collection of soil samples for laboratory tests.

Six rotary test holes were drilled across the valley along the axis of the proposed dam. Total footage in the six holes amounted to 740 feet. Approximately 525 feet of coring was attempted in the underlying slightly to moderately compacted Tehama formation of Plio-Pleistocene age, with a core recovery of about 88 per cent. In addition to the six deep test holes, nineteen shallow

power auger holes were drilled in the abutments to determine depths of overburden and physical characteristics of sediments, and twelve shallow hand auger holes were drilled in the valley fill to obtain soil samples for laboratory tests. Seven additional soil samples from test pits and two samples of the stream channel gravels were obtained for various soil tests. Detailed results of soil tests and a seismic survey are in the files of the Department of Water Resources. Cores of the Tehama formation from the six test holes are available for inspection.

The surface distribution of the geologic formations in the reservoir area is shown on Plate C5, entitled "Geology of Reservoir Area and Location of Soil Samples, Guinda Dam Site". Detailed distribution of geologic formations and subsurface sequence of stratigraphic units and structural conditions of the dam site are shown on Plate C6, "Surface and Subsurface Geology and Location of Test Holes, Guinda Dam Site".

Conclusions

As a result of the geologic surveys and studies during the current and prior investigations, the following conclusions have been reached.

Wilson Valley Dam Sites

1. The presence and depth of Cache formation sediments at the spillway, the gouge zone in the channel, and the thickness of the colluvial material on the right abutment make the upper site less desirable than the lower site.

2. Geologically, the lower site is best adapted to an

earthfill type dam with a spillway either through the saddle northeast of the left abutment or along the left abutment.

Guinda Dam Site

1. Preliminary geologic studies have not indicated the presence of any serious defects that might preclude the construction of an earthfill dam at this site.

2. The site is best adapted to an earthfill type dam with a spillway through an existing saddle behind the left abutment.

CHAPTER II. GEOLOGY OF WILSON VALLEY DAM SITES

The following discussion of the geologic characteristics of the Wilson Valley dam sites, based on the findings of prior reports and field investigation by Department geologists, includes surface geologic mapping, underground exploration, and material sampling and testing.

General Geology

The geologic formations in the Wilson Valley area consist of sedimentary and ultra-basic rocks of Upper Jurassic age, unconsolidated lacustrine and fluviatile deposits of Plio-Pleistocene age, and Recent terrace and alluvial deposits.

The Knoxville group of Upper Jurassic age is the oldest lithologic unit encountered in this area. The sediments found consist primarily of gray to black marine shale and siltstone interbedded with smaller amounts of graywacke-type sandstone, deposits of chert and limestone varying from thin beds to lenticular bodies, and locally prominent conglomerate zones. The sedimentary beds trend generally N40°W to N70°W and dip 40° to 80° northeast; although some beds are vertical. The predominant strike in the spillway area of the lower site is N20°W. Ultra-basic rocks, predominantly altered to serpentine, occur in large bodies throughout the Jurassic formations of the Coast Range, but no outcrops of this material are evident along Cache Creek in the vicinity of the dam sites. A large body of serpentine, trending northwestwardly, was mapped 0.5 mile east of the proposed dam sites.

The Cache formation, of Plio-Pleistocene age, is a thick deposit of poorly consolidated gravel and silt that was laid down in

rivers and fresh water lakes. The major portion of this formation terminates at the upper end of Wilson Valley. However, an outcrop approximately 3,000 feet long was mapped in the proposed spillway area of the upper site. The maximum thickness of the Cache formation, as determined in the report on "Geology of Lower Lake Quadrangle", exceeds 1 mile. Cache beds in the above-noted outcrop area exceed 177 feet in thickness, as indicated by hole WV1L, and probably are not more than 400 feet thick locally. This maximum thickness in the dam site vicinity was determined from the cross section B-B', as shown on Plate C2.

Recent terrace deposits cover the major portion of Wilson Valley except in the present channel area of Cache Creek. The terrace deposits consist of well-compacted, light-brown to tan silts underlain by coarser gray-brown sandy and gravelly silts. Gravel beds and sand lenses were also found. The depth of terrace beds and lenses exceeds 20 feet as determined by auger holes drilled in the proposed borrow areas of the valley. Several terrace deposits were found at elevations higher than Wilson Valley indicating Pleistocene or younger uplift and rejuvenation in that age.

Within the channel are found Recent alluvial and stream channel deposits. These deposits are composed primarily of highly pervious loose sand and gravel. Red sandy clay forms a matrix for a few of these deposits.

Although the U. S. Corps of Engineers mapped extensive areas adjacent to Cache Creek as Quaternary landslide debris, i.e., slides of all rock types, recent exploration of the Department of Water Resources has indicated this material is the mantle of soil and broken rock identical to the fresher material found beneath. A

better term than landslide debris would be colluvial material, and this terminology is employed in this report.

True landslides and talus deposits, although not extensive in the dam site area, are exceedingly common. The majority of these occur on a dip slope where the present stream parallels the strike of the underlying Knoxville group.

The general structural features of this region of the Coast Range are large complex folds with northwestwardly trending axes which are several miles in length and moderately narrow in width. Throughout the region steeply dipping faults also trend in a northwestward direction. Some have a length of many miles with displacements measurable in hundreds of feet.

Deformation is much less pronounced in the Plio-Pleistocene Cache formation than in the underlying older sediments. Dips in the Cache formation rarely exceed 30° and commonly are nearly horizontal.

Faulting in this region is indicated by zones of crushed and slickensided sediments and abnormally straight contacts between formations. Minor faults are indicated by the observed displacement of strata. The majority of faults mapped were discernible only because they are, in part, contacts between major rock units. Other large faults are probably present within the major rock units as discussed in the James C. Brice report but are not discernible because of the uniformity of the unit and soil cover.

The general topography of this region consists of irregular hilly areas, the drainage of which is generally adjusted to the northwest structural trend. However, the stream pattern is complex with many insequent gullies dissecting the topography. Most of the regions

in the stream valleys are now in the geomorphic stage of early maturity. Several irregular flat-bottomed valleys, such as Wilson Valley, are seen throughout the area.

Geology of Upper Dam Site

Foundation rock at the proposed upper site consists of steeply dipping consolidated Knoxville shales, siltstones, and sandstones overlain by the poorly consolidated Cache formation. Terrace gravels outcrop on the left abutment. Silts, sands, and gravels occur within the stream channel in deposits of considerable thickness.

Left Abutment

The lower portion of the left abutment consists of badly fractured beds of Knoxville shales and siltstones. The strike of these beds generally intersects the stream channel at 10° to 30°. Overlying the Knoxville group is an outcrop of relatively pervious terrace gravels which forms a gently sloping nose. The thickness of these terrace gravels, as determined from the U. S. Corps of Engineers drill holes 7F-1, is 8 feet. Farther down the slope this deposit probably increases in thickness. Core obtained from the 7F-1 drill hole also indicated that the Knoxville formation consists of fine, dense, fractured brown clay shales. The prominent dip of the formation is 50°. Beds of the poorly consolidated and moderately pervious Cache formation overlie the Knoxville group and extend northeastwardly from near drill hole WV2L to beyond the spillway location. Drill hole WV1L indicates that the Cache formation is at least 177 feet thick. This pervious part of the left abutment would require

impervious blanketing throughout its extent below the water surface. No indication of faults through this abutment was evident. A moderate grout take would be required to produce a satisfactory foundation.

Right Abutment

The Knoxville group forms the foundation rock of the entire right abutment as shown on Plates C1 and C2. The beds on this side of the creek strike more nearly east-west than on the left abutment, thus giving the indication of a possible fault in the channel. General lithology is the same as the Knoxville group of the left abutment. Drill hole RA-1 indicates that this abutment would have to be stripped a minimum of 35 feet. Logs of the U. S. Corps of Engineers drift 4F-1 show west dipping fractured shales and siltstones overlain by 15 feet of overburden. These logs indicate a water seep at the extreme end of the drift. Grout take would probably be moderate.

Channel Section

Recent alluvial and stream channel deposits cover the channel section to a depth of approximately 15 feet. These deposits are composed of silts, sands, and gravels. The gravels vary in size from granules to boulders. These are lying on the Knoxville group through which Cache Creek has cut its present channel. The Kennedy fault, recently mapped by Lawton and discussed in his report, is found intersecting the axis at mid-channel. This near vertical fault zone, with a minimum width of 45 feet, consists of gouge material as indicated by drill hole LC-1. Several shear zones and one

gouge zone approximately 10 feet wide in horizontal projection were seen in drill hole RC-1, which penetrated only a short distance into the fault zone. The Kennedy fault zone has a great bearing on the feasibility of this upper dam site. This will be indicated in the section on stripping estimates. Grout take for the channel section in general would probably be moderate.

Stripping Estimates

The following stripping estimates given are for the proposed earthfill dam. Depths of stripping are estimated normal to the ground surface.

On the left abutment an average of 5 feet would have to be stripped from the entire slope. The area beneath the impervious section would require an additional stripping of 15 feet. This should remove the weathered and fractured zone and should expose suitable foundation materials.

On the right abutment an average of 40 feet would have to be stripped from the entire slope. This should remove the weathered zone and colluvial material and expose suitable foundation material.

The channel width between abutments is approximately 130 feet, and the channel section is filled with Recent alluvial deposits averaging 15 feet in depth. Beneath these deposits there are about 10 feet of weathered bedrock and a zone of about 45 feet of badly broken bedrock and gouge material. These unsuitable materials must be removed before placing the impervious fill.

The above stripping should expose a suitable foundation for the impervious section of the proposed dam. Only the excavation necessary for shaping the foundation will be required beneath the pervious fill.

Spillway

The proposed spillway would be located through the saddle north of the left abutment. Due to the depth of the poorly consolidated, moderately pervious Cache formation, the spillway would require impervious blanketing of this zone below the water surface. If it could be determined that an impervious zone or bed exists, such extensive blanketing would not be necessary.

Due to the presence of Cache formation beds over 150 feet thick at the upper site, the construction of the spillway there would require careful engineering consideration regarding blanketing. Downstream protection of the spillway area and the earthen dam would also have special engineering requirements because of erosion problems. In any event, lining of the entire spillway would be necessary.

The Wilson fault, if present, would not create any problem due to its distance from the spillway location.

Reservoir

Leakage from the upper reservoir through the Knoxville formation would be slight. However, leakage from the reservoir of the upper dam through the relatively pervious Cache formation on the left abutment could possibly be great unless suitable precautions are taken.

Several cattle ranches lie within the proposed reservoir. Few crops are grown; however, some apiaries are found in the reservoir area. A section of State Highway 20 which crosses the proposed reservoir, the bridge across North Fork Cache Creek, and the Cache Creek school would have to be relocated if a dam is built at this axis.

Geology of Lower Dam Site

Except for the stream channel deposits the foundation rock at the lower site consists entirely of lithologic units of the Knoxville group. The Knoxville units include, in decreasing order of abundance, silty sandstones, siltstones or mudstones, and silty shales. Calcite veining is present locally. The Recent channel deposits consist of highly pervious sand and gravel. The Knoxville beds strike across the channel and dip rather steeply upstream.

Left Abutment

The entire abutment consists of alternating beds of Knoxville sandstones and siltstones with minor mudstones and shales as shown on Plates C1 and C2. The one left abutment drill hole (LA-1) indicated that this abutment is highly fractured and weathered to 20 feet below the ground surface. Below that depth, water loss was 100 per cent throughout the 103.0 feet of hole. This indicated that the rock is badly fractured to that depth. However, this hole penetrated only 40 feet into the abutment, on a line perpendicular to the surface. This abutment has a very steep face near the stream channel; consequently, only minor slides of weathered surface material are evident. Hole 1F-4 of the U. S. Corps of Engineers indicates a weathered zone 10 feet thick which consists of shale and sandstone fragments. The remaining 152 feet of this hole consists of sandstones and silty shales, locally veined with calcite. Due to the fractured nature of the material the grout take would probably be moderate.

Right Abutment

This abutment is also composed entirely of lithologic units of the Knoxville group. As on the left abutment, sandstone ribs

appear to be predominant over the more easily weathered siltstone. The steeply dipping character of the beds and the fact that the beds strike across the channel have limited the formation of slide material, especially on the lower slope of this abutment. The three drill holes located on this abutment indicate that soil cover is about 2 feet deep and that the zone of highly fractured and weathered sandstones and siltstones varies from 10 to 20 feet deep. Grout take would be moderate, but less than at the upper site.

Channel Section

Recent alluvial and stream channel deposits cover the channel section to a maximum depth of 12 feet. Below the stream channel deposits the Knoxville formations are broken, fractured, and iron-stained to a depth of about 30 feet. Drill holes RC-1 and LC-1 showed that the siltstones, sandstones, and shales found in the channel are suitable for the proposed earthfill dam. Grout take would be moderate due to the fractured nature of the foundation rock. No evidence of a fault could be inferred from either of the two channel holes.

Stripping Estimates

The following stripping estimates are for the proposed earthfill dam. Depths of stripping are estimated normal to the ground surface.

On the left abutment approximately 10 feet of loose bedrock and soil would have to be stripped from the slope. The area beneath the impervious section would require additional stripping of 30 feet to expose suitable foundation material.

On the right abutment approximately 5 feet of soil should be removed from the entire abutment area. An additional 20 feet of weathered and broken bedrock would have to be stripped from the impervious core area.

The channel width between abutments is approximately 150 feet. The channel section is filled with an average thickness of 15 feet of stream channel deposits underlain by about 15 feet of weathered bedrock. All of this material must be removed from beneath the impervious section. However, only the excavation necessary for shaping the foundation will be required beneath the pervious fill.

Spillway

The proposed spillway for this site may be located either through the saddle northeast of the left abutment or along the left abutment. The entire spillway area is underlain by mudstones, siltstones, and sandstones of the Knoxville group. Although no drill holes were included in the recent exploration program, extensive trenching was completed during November, 1956.

The trenching program included five exploratory trenches and three angle cuts as shown on Plate C1. The trenches were excavated to determine the character of the spillway materials in regard to both foundation and earthfill characteristics. The angle cuts, one 30°, one 45°, and one 60°, measured from a horizontal plane, were designed to test the stability of slopes in Knoxville mudstones and sandstones. Inspection at a later date will give an indication of the stability of the spillway cuts. The average strike and dip of the beds intersected by the trenches was N20°W and 44°NE, respectively.

The depth and amount of excavation for this spillway, as indicated by Plate C2, would be considerable. The spillway cuts should

be stable at slopes of approximately 1:1. Due to the extreme depth of cut, benches at regular intervals might prove essential. Removal of the material would be classified as common excavation. Lining of the entire spillway and probably some type of cutoff would be necessary to prevent erosion of the Knoxville sediments.

Reservoir

Leakage from the reservoir through the Knoxville formation would be slight.

Several cattle ranches lie within the proposed reservoir. Few field crops are grown; however, some apiaries are found in the reservoir area. A section of State Highway 20 which crosses the proposed reservoir, the bridge across North Fork Cache Creek, and the Cache Creek school would have to be relocated if a dam is built at this axis.

Seismicity

The proposed Wilson Valley dam sites are not located in an area of strong seismic activity. However, several shocks have occurred in the past which would probably have caused damage to an earth dam or such related structures as canals and tunnels. These shocks were located in the vicinity of Clear Lake.

Intensities of earthquakes discussed below correspond to the Rossi-Forel Scale of Earthquake Intensity. This scale ranges from I to X in intensity. It is based on reports of persons feeling the shocks and on the damage incurred.

Three shocks of intensity VI were recorded on April 29, 1955, with the epicenter near the town of Kelseyville. These were sharp

shocks felt over an area of approximately 900 square miles in the vicinity of Clear Lake. The over-all damage was slight. An intensity of IV was reported from Lakeport, Morgan Valley, and Siegler Springs.

Three shocks were again recorded on May 7, 1955. The intensity was recorded as VI with the epicenter again near the town of Kelseyville. The second and principal shock was felt over an area of approximately 2,000 square miles, primarily in Lake County. Moderate damage occurred to buildings, and some ground cracks appeared at Clearlake Park.

The location of the above epicenters is approximately 20 airline miles from the dam sites. Although no epicenters have been recorded in the immediate vicinity of the dam site, it is reasonable to assume that this area could be subjected to earthquakes of considerable intensity.

The location of the epicenter and the delineation of shock zones is shown on Plate C4, "Isoseismal Map for Earthquake of May 7, 1955".

Suitability of Sites

Both the upper and lower sites appear to be best suited for earthfill type dams. The upper site is unsuitable for a concrete-gravity type dam. Further exploration at the lower site might justify consideration of that axis for a low concrete-gravity type dam.

Preliminary tests indicate that the rocks of the Knoxville group would provide a satisfactory foundation for the earthfill dam under consideration.

As indicated in the introduction, one purpose of this report was to determine the relative feasibility of the two proposed dam

sites. From the included data it is evident that the lower site is more suitable for an earthfill dam than the upper site. The primary disadvantages of the upper site are the presence and depth of Cache formation sediments at the spillway, the gouge zone in the channel, and the thickness of the colluvial material on the right abutment.

Construction Materials

Aggregate

Channel deposits extending 1.3 miles downstream from the State Highway 20 bridge across the North Fork Cache Creek were sampled and found to be suitable for use as concrete aggregate. The average haul distance for this group of deposits is approximately 6 miles from the lower axis measured along the stream channel. Based on an average depth of 3 yards, the volume of the aggregate materials is conservatively estimated to be 500,000 cubic yards. Location of the aggregate material is shown on Plate C3, "Possible Sources of Construction Materials, Wilson Valley Dam".

Pervious Fill

A group of channel deposits considered best suited for use as pervious fill extends along Cache Creek from the south end of Wilson Valley to the lower dam site. The average haul distance for this group of deposits is approximately 1 mile from the lower axis measured along the stream channel. Samples were taken near the lower dam site axis. The results of laboratory tests made on these samples showed them to be better suited for use as pervious fill than aggregate because of grading deficiencies. However, such material, with proper processing, may be used for aggregate. No special processing

is contemplated for their use as pervious fill. Based on an average depth of 3 yards, the volume of this group of channel deposits is conservatively estimated to be 364,000 cubic yards. For the location of pervious material see Plate C3.

The channel deposits extending upstream approximately 2 miles from the State Highway 20 bridge over North Fork Cache Creek have not been sampled, but are probably suitable for use as pervious fill. The average haul distance for this group of deposits is approximately 9 miles from the lower axis, measured along the stream channel. Based on an average depth of 3 yards, the volume of the above-mentioned deposits is conservatively estimated to be 2,173,000 cubic yards. The area is not designated on Plate C3.

A third group of channel deposits extends from approximately 1 mile below the State Highway 20 bridge over North Fork Cache Creek to the confluence of Cache Creek with Rocky Creek. These deposits have been examined only visually in the field. They are probably suitable for use as pervious fill. The average haul distance for this group of deposits is approximately 5 miles from the lower axis, measured along the stream channel. Based on an average depth of 3 yards, the volume of the deposits is conservatively estimated to be 1,213,000 cubic yards. For location of these deposits see Plate C3.

A fourth group of channel deposits extends approximately 4 miles downstream from the lower axis. No samples from these deposits have been tested, but they are probably suitable for use as pervious fill. The average haul distance for this group of deposits is approximately 2 miles from the lower axis, measured along the stream channel. Based on an average depth of 3 yards, the volume of this group of deposits is conservatively estimated to be 888,000 cubic yards. This area is not designated on Plate C3.

The combined volume of the latter three groups of pervious materials is 4,274,000 cubic yards.

Impervious or Random Fill

Deposits in Wilson Valley were sampled and found suitable for use either as impervious fill or properly drained random fill. Approximately 8,500,000 cubic yards of this material are estimated to lie within Wilson Valley. The average haul distance for these deposits is approximately 2 miles from the lower site measured along the dirt road between Wilson Valley and the lower dam site. For the location of these materials see Plate C3.

An additional probable source of impervious material is the silty phase of the Cache formation. This formation outcrops in the spillway area of the upper site and northwest of Wilson Valley.

Riprap

Sufficient riprap material can probably be obtained from peridotite bodies outcropping along Rocky Creek approximately 2 miles west of the dam sites. The exact limits of the outcrops cannot be ascertained until additional exploration is conducted. For the location of riprap materials see Plate C3.

Summary

1. Both abutments and the spillway of the lower site are underlain by relatively impervious siltstones, mudstones, and minor sandstones of the Knoxville group of Upper Jurassic age. These sediments dip steeply upstream.

2. The channel section of the lower site is filled with an average thickness of 15 feet of stream channel deposits which must

be removed. An additional 15 feet of bedrock below this should be removed.

3. Stripping of approximately 10 feet of the upper portions of both abutments and approximately 40 feet under the impervious core area should expose suitable foundation material for the proposed earthfill dam at the lower site. Approximately 10 feet of unsuitable material would have to be excavated from any spillway located on the left abutment. However, depth and amount of excavation for a spillway through the saddle northeast of the left abutment would be considerable. These spillway cuts should be stable at slopes of 1:1. Due to the extreme depths of cut necessary to reach the spillway lip, benches at regular intervals might prove essential.

4. Ample quantities of fill materials can be obtained within a maximum distance of 11 miles upstream from the lower site along North Fork Cache Creek and 4 miles downstream from the lower site along Cache Creek. Aggregate materials are available in this same general area, but they must be sampled and tested more extensively to determine their suitability for concrete aggregate. Riprap may be obtained from peridotite outcrops along Rocky Creek approximately 1.5 miles west of the dam site.

CHAPTER III. GEOLOGY OF GUINDA DAM SITE

The following discussion of the geologic characteristics of the Guinda dam site is based on data from prior reports and on field investigation by the Department of Water Resources which included surface geologic mapping, subsurface exploration, and materials sampling and testing.

General Geology

The geologic formations in and adjacent to Capay Valley include sedimentary rock types which range in age from Cretaceous to Recent. Sandstone and shale of Cretaceous age extend beneath the entire area, and are overlain locally by semi-consolidated Tertiary sediments, by unconsolidated Pleistocene terrace gravels, and by Recent alluvium as shown on Plates C5 and C6.

The Chico group of Cretaceous age, as described by J. M. Kirby in his "Rumsey Hills Area" report, is the oldest lithologic unit in the area and includes alternating beds of marine sandstone and shale. The sequence is occasionally broken by beds of conglomerate. In general, the sandstone and conglomerate strata are thickly bedded, hard, and well cemented except on weathered surfaces where these rocks become friable. The shale strata are usually thinly bedded and highly fractured. Thickness of the Chico group in this area is approximately 12,000 feet.

Overlying the Chico group and outcropping along the western flank of Capay Valley is the Capay formation of Eocene age. This was established by Crook and Kirby in their investigations. Rock units in this formation consist of a brown colored, tough marine clay shale with interbedded hard, well-cemented and gray

micaceous sandstone. The shales characteristically are thinly bedded, somewhat fractured, and have an uneven bedding surface. Thickness of this formation reaches a maximum of 2,500 feet in the area southwest of the town of Guinda.

The Tehama formation of Plio-Pleistocene age overlies the Capay formation and the Chico group as pointed out by Kirby. This formation underlies all of the valley floor and outcrops along the eastern and western flanks of Capay Valley. The Tehama formation consists of non-marine clay, clayey and sandy silt, sand, gravel, conglomerate, marl, and limestone. The finer grained sediments are red-brown or pale buff. Sand, silt, and clay which make up the major part of the formation in this area are commonly massive and show little structure. The formation attains a maximum thickness of 1,500 feet on the east flank of the Rumsey Hills according to J. M. Kirby. It is probably 1,000 to 1,500 feet thick in the trough of Capay Valley.

Pleistocene and Recent unconsolidated sediments cover the valley floor and overlie the Tehama formation. The Pleistocene sediments are stream terrace deposits ranging in size from small gravel to boulders. Voids are generally filled with a reddish matrix consisting of sand and silt. At least four terrace levels have been formed by the erosive action of Cache Creek. The gravels attain a maximum thickness of 45 feet adjacent to the right abutment of Guinda dam site. Recent alluvium along the active channel of Cache Creek occurs as sand and gravel bars and undifferentiated flood plain deposits. Cache Creek, in the area of the Guinda dam site, has cut through the Pleistocene terrace gravels and is now entrenched in the Tehama formation. The alluvium, consisting of unconsolidated gravel, sand, and silt, is a thin deposit and for the greater part immediately overlies the Tehama formation.

Structurally, Capay Valley is a broad, elongated, synclinal valley in the southeast portion of the Northern Coast Ranges geomorphic province. Capay Valley, which is approximately 16 miles long and ranges in width from 1 to 2 miles, is bounded on the east by the Rumsey Hills which represent the surface expression of an asymmetrical anticline. West of Capay Valley the strata are homoclinal, and generally display an easterly dip. Minor folds are also present, and will be discussed under geology of the dam site.

The major known faults in the area, first mapped by Kirby, are the Sweitzer fault and the Eisner thrust fault, as shown on Plate C5. Both structures occur on the western limb of the Rumsey Hills anticline at an elevation well above the top of the dam and spillway area. The Sweitzer fault forms a prominent escarpment along the western flank of the Rumsey Hills and extends for nearly their entire length. The Eisner fault is a short, low angle thrust fault occurring only between the small towns of Guinda and Rumsey. Due to a westerly movement along this fault, nearly horizontal Cretaceous sediments have been thrust over vertical Cretaceous sediments as well as over gravels in the Tehama formation.

The presence of the Sweitzer and Eisner faults in the left abutment area will not constitute a problem as far as stripping or grouting is concerned as the surface trace of the Eisner fault, which is the lower of the two faults, is approximately 0.5 mile east of the left abutment and approximately 150 feet in elevation above the proposed crest of dam.

Geology of Dam Site

Foundation rock at the proposed dam site consists of consolidated sandstone and shale of the Capay formation of Eocene

age overlain by semi-consolidated sandy and clayey silt, the conglomerate of the Tehama formation, and by unconsolidated Pleistocene and Recent sediments in the valley floor. Consolidated sandstone and shale of Cretaceous age underlie the proposed dam site at considerable depth beneath these younger sediments.

Left Abutment

The Tehama formation of Plio-Pleistocene age forms the foundation rock of the entire abutment, as is shown on Plates C5 and C6. Consolidated sandstone and shale of Cretaceous age underlie the Tehama at considerable depth. The lithologic units exposed include a thin cemented conglomerate overlain by a thick section of compacted silts. The conglomerate outcrops in essentially horizontal beds at the base of the abutment and extends upward to a height of approximately 60 feet. The gravels were probably laid down in a shallow stream bed and later cemented by calcium carbonate into conglomerate. This portion of the abutment would probably accept a moderate amount of grout.

Overlying the conglomerate and extending upward to and above the top of proposed dam is a silty phase of the Tehama formation. This material represents a weathered phase of the silt similar to that cored in the six test holes in the valley fill, and comprises clayey silt and clay, stringers of marl, and occasional sand and gravel lenses.

Structurally, the left abutment is near the crest of a small asymmetrical anticline as shown on Plate C6. The west limb of this fold has been partially removed by erosion and covered by

Pleistocene gravels at the base of the abutment adjacent to Cache Creek. East of the crest of the anticline the Tehama formation dips to form a small syncline. The saddle east of the right abutment is probably a topographic feature developed along this syncline. The eastern limb of this syncline is steeply inclined and has a westerly dip of approximately 60°.

Right Abutment

The Tehama formation forms the foundation rock of most of the right abutment. These deposits, similar in lithology to the left abutment, probably occur as a relatively thin layer over the underlying Capay formation of Eocene age. The underlying Capay formation, which outcrops high on the abutment, is predominantly a cemented gray micaceous sandstone and brown clay shale. The Capay and Tehama formations in the abutment dip gently to the east in a uniform homoclinal dip. Immediately west of the abutment the Capay formation dips to the west, indicating the presence of an anticlinal fold in the abutment area.

Channel Section

Pleistocene terrace deposits and the underlying Tehama formation form the foundation rock of the entire channel section, as shown on Plate C6. Recent alluvium occurs in the present stream channel of Cache Creek. The Tehama formation underlies the valley floor at shallow depth and may be in the order of 1,000 to 1,500 feet in thickness.

A seismic profile normal to Cache Creek was made of the Guinda dam site by the Department of Water Resources. The purpose

of this survey was to obtain data on foundation conditions at this site and to aid in the selection of locations for test holes. The thickness of the alluvial fill in the valley was thought to be large, but it was hoped that an impervious clay layer, which might serve as a satisfactory foundation, might be found.

The seismic method determines differences in the speed of shock wave transmission of the various materials underlying the ground surface. Because of this varying transmitting capacity of different lithologic units, it is possible to compute their thickness. This method, however, is not capable of ascertaining directly the lithologic nature of the material being investigated, nor is it capable of determining the thickness of the lowest stratum studied.

The seismic survey indicated the presence of several horizons at shallow depth. A horizon is defined as a layer of homogeneous material differing from that found above and below it. The thickness and physical character of these horizons could not be determined by the survey. An upper horizon was continuous across the valley to the west of Cache Creek. Thickness of overlying material was 50 to 60 feet over the westerly half of the valley, and decreased gradually to about 10 feet over the easterly half. A second horizon was also indicated beneath Cache Creek at a depth of about 30 feet. This horizon was traced about 700 feet to the west of Cache Creek and about 150 feet to the east of the creek. It was not possible to determine if this second horizon was continuous beneath the first horizon.

Cores obtained from six test holes drilled across the valley show the Tehama formation to consist predominantly of compact red-brown sandy and clayey silts and clays, usually containing black

carbonaceous fragments and a variable amount of calcium carbonate as small concretions. Frequently the silts graded into a highly calcareous silt or clay forming a material commonly referred to as marl. Thin gravel and sand bodies saturated with water occur in the Tehama formation beneath the valley surface. They may contain confined water as indicated in test hole No. 6. There is no information available as to the possible outcrop area of these saturated sand and gravel lenses in the reservoir area or in the valley floor downstream from the dam site. Gravels and sands cemented with calcium carbonate are also present but are localized in occurrence. In general, the material encounted in the upper part of the Tehama is a compact silt with varying amounts of clay and sand, and is similar to the unweathered silty sediments in the right and left abutments and in the spillway section. However, in test hole No. 5, a large portion of the material recovered was loose water-bearing sand and gravel from a depth of 18 to 48 feet. Below this depth a greater amount of compact, relatively impermeable material was recovered.

Deformation due to probable folding and/or faulting in the Tehama formation is manifest in shears found in cores from three of the six test holes, Nos. 1, 4, and 6. Evidence of shearing is minor in all but one test hole -- test hole No. 1 adjacent to the right abutment -- where Tehama silts are badly sheared and highly fractured from 14 feet to 38 feet in depth. Only four shears were found below 38 feet. Either sharp folding or faulting may be responsible for the fractured and sheared condition of the rock here. Further exploration would be necessary to establish the type and extent of this deformation.

Overlying the Tehama formation are Pleistocene terrace gravels which vary in thickness from 0 to 45 feet. Although no

cores were obtained from these terraces, drilling evidence indicated that very coarse material and permeable zones exist down to the Tehama formation.

These terrace deposits are composed of gravels ranging in size from pebbles to boulders. This coarse material is in a matrix consisting of sand, silt, and clay. Results from soil tests indicate that a large portion of this material could be used for fill material. Although the material sampled contains a large percentage of fines, which would reduce the permeability, test hole data and some exposures of these terrace deposits indicate that it is locally permeable, and hence a cutoff to the Tehama formation is believed to be desirable.

An unknown thickness of Recent alluvium underlies the present stream channel of Cache Creek. These unconsolidated alluvial deposits in the stream channel consist of sand and sandy silt with interbedded rounded gravel and boulders. Soil tests indicate these deposits are suitable for use as gravel drains.

Stripping Estimates

The following stripping estimates are based on visual observations of the material exposed, and on material recovered from auger holes and test pits. The estimates given below are for a homogeneous earthfill dam. Depths of stripping are estimated normal to the ground surface.

Tehama conglomerate occurring at base of the left abutment extends up the slope to elevation 430 feet, or to a height of 60 feet. A silty phase of the Tehama formation overlies these

conglomerates and extends to the top of the abutment. It would be necessary to strip 2 to 3 feet of conglomerates and 3 to 5 feet of Tehama silt to remove the weathered zone.

On the right abutment it would be necessary to strip approximately 3 to 5 feet on the entire slope. This should remove the weathered zone and expose suitable foundation material. On this abutment the Tehama may be thin and overlie an old weathered surface of the Capay formation. Therefore, further stripping might be necessary.

Valley width between abutments is approximately 1-1/3 miles. The channel section is filled with a maximum of 45 feet of Pleistocene terrace gravels with a probable average thickness of 20 feet. An unknown thickness of unconsolidated Recent stream channel deposits underlie the present course of Cache Creek. These deposits are probably thin, but there are no test hole data to substantiate this.

Approximately 5 feet of soil should be stripped throughout the channel section, except where deep excavation would be necessary for a cutoff wall through the terrace deposits. Additional stripping under the cutoff section might be required adjacent to the right abutment where the Tehama formation is badly fractured below the terrace gravels. In this area, test hole No. 1 indicates that up to 20 feet of material might have to be removed due to fracturing and shearing.

Spillway

A satisfactory location for a spillway for an earthfill dam at this site would be through the saddle east of the left abutment. Some excavation in the silty phase of the Tehama formation

would be necessary, especially at the north and south ends of the saddle. Spillway cuts should be stable at slopes of approximately 1:1. The material could easily be removed as common excavation. The material from such excavation could probably be used as impervious fill in the dam and in the small gap occurring along the crest of the abutment. Lining of the entire spillway and probably some type of cutoff would be necessary to prevent erosion of the soft Tehama sediments.

Between the saddle on the left abutment and the Eisner fault to the east, the intervening hills of relatively low relief may be overlain by a zone of slide material of undetermined thickness which could have originated from the steeper hills above the Eisner fault. This condition should not constitute a threat to the spillway structure as the slopes are not steep and appear to be stable. The spillway should be located as close to the left abutment as possible, thereby avoiding cuts into the base of these hills.

Reservoir

Leakage from the reservoir would probably be small due to the fine-grained character of the Tehama formation which underlies the entire reservoir area. However, coarse-grained members of the Tehama formation which may outcrop in the reservoir area will continue to recharge the ground water basin immediately downstream from the proposed dam.

Several ranches and the small community of Rumsey lie within the proposed Guinda Reservoir. Land use is predominantly orchard, with some grain. A portion of State Highway 16, where it passes through the reservoir area, would have to be relocated.

Seismicity

The proposed Guinda dam site is located in an area of only moderate seismic activity. However, the following is a discussion of three shocks which occurred in the general vicinity of Winters and Vacaville that probably would have been damaging to some structures such as canals and perhaps to the earth dam. This information was obtained from the "Earthquake History of the United States". Intensities listed in Roman numerals correspond to the Rossi-Forel Scale of Earthquake Intensity.

On April 19, 1892, the shocks varied from IX to X. In Vacaville nearly all of the brick structures were wrecked, and many frame buildings were damaged. Chimneys were twisted or thrown down. The loss varied from $70,000 to $150,000. In Dixon the damage was less serious, but many structures, especially schoolhouses, were badly damaged. The loss was estimated at $75,000. At Winters the damage was similar to that in Vacaville and the loss was about the same. There was more or less damage at numerous other places in Solano and Yolo Counties. One chimney toppled at Sacramento and there was slight damage at San Francisco. Fissures were found in the bed of Putah Creek 0.5 mile west of Winters, and in the adjoining roadway and fields. Shock was felt from Healdsburg to Fresno and east to western Nevada.

On April 21, 1892, the shocks varied from IX to X. Total energy was probably less but the intensity was as great as the shock of April 19. The most severe shock was at Winters, about 12 miles north of Vacaville. Many buildings which had withstood the previous shock were leveled to the ground. On Main Street not a single building was left in habitable condition. The buildings were

constructed mostly of brick or stone. At Esparto every brick chimney fell and wooden buildings were wrenched out of shape. Damage at Vacaville and Dixon was not great. Many chimneys were wrecked at Sacramento and there was other small damage. There were varying degrees of damage in Solano, Yolo, Sonoma, Napa, Contra Costa, Butte, Nevada, San Joaquin, and Yuba Counties. The shock was felt with an intensity of V at Red Bluff to the north, at Reno to the east, and with a lesser intensity at Fresno to the south.

On May 19, 1902, a shock with maximum recorded intensity of VIII occurred. The intensity was VII at Elmira, where nearly all chimneys fell; VII to VIII at Vacaville, where some chimneys tumbled; VII at Fairfield and Suisun; and V at San Francisco. The area of perceptibility exceeded 20,000 square miles, based on incomplete reports.

The locations of the shocks felt in the vicinity of Winters and Vacaville are approximately 30 to 40 miles, respectively, from the dam site. However, due to the relatively unpopulated nature of the area at that time, complete reports are not available.

Although no epicenters have been recorded in the immediate vicinity of the dam site, it is reasonable to assume that this area could be subjected to earthquakes of considerable intensity.

Suitability of Site

This site appears to be suited to only an earthfill type dam. The foundation material is probably susceptible to some settlement; therefore precluding the construction of a masonry type dam. Preliminary tests indicate that the terrace deposits and the Tehama formation would form a suitable foundation for the earthfill dam under consideration.

Construction Materials

The terrace deposits in the reservoir area should provide ample quantities of fill material for the proposed type of dam. Approximately 500 acres in the immediate vicinity of the dam would yield about 11,500,000 cubic yards if stripped to a depth of approximately 15 feet.

Select borrow material for the core of the dam may be found in the Tehama formation east of Cache Creek and within 1 mile upstream from the site. Excellent exposures of this material can be found at "Blue Slides", 1.5 miles southeast of Rumsey. Within 2.5 miles upstream of the proposed axis, approximately 500,000 cubic yards of stream channel gravels are available and are apparently suitable for use as gravel drains.

Riprap may be obtained from the Upper Cretaceous sandstone which is exposed in the adjacent hills approximately 2 miles upstream from the axis. Moderate loss may be expected in quarrying this material due to the interbedded shale and fractured sandstone member.

Soil Tests

Soil samples were obtained and tests were conducted to determine the character of the construction and foundation materials. Results from these tests were utilized to develop the engineering designs and the estimates of the proposed Guinda dam.

A complete explanation of these tests is presented in the geologic appendix of the report entitled, "Interim Report - Cache Creek Investigation, March, 1955".

Summary

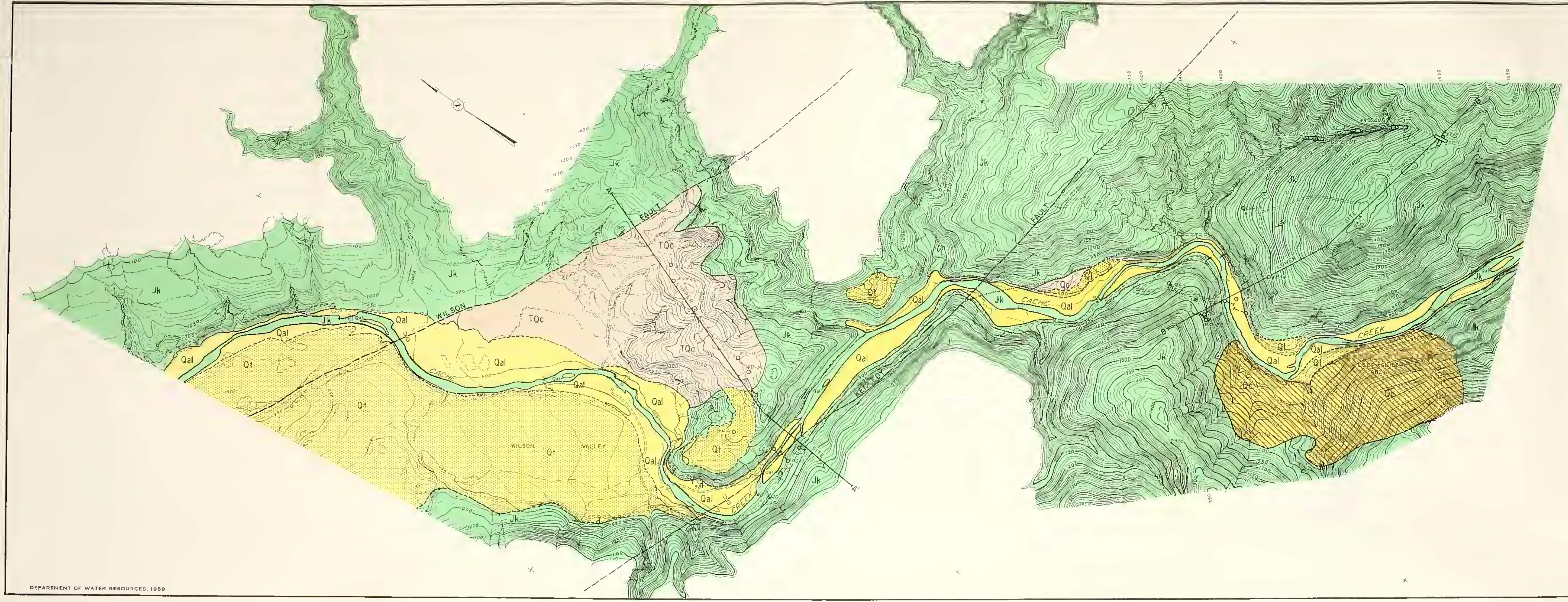
1. Both abutments and the spillway are underlain by slightly to moderately compacted silts, clay silts, and marls with sand and gravel lenses of the Tehama formation of Plio-Pleistocene age.

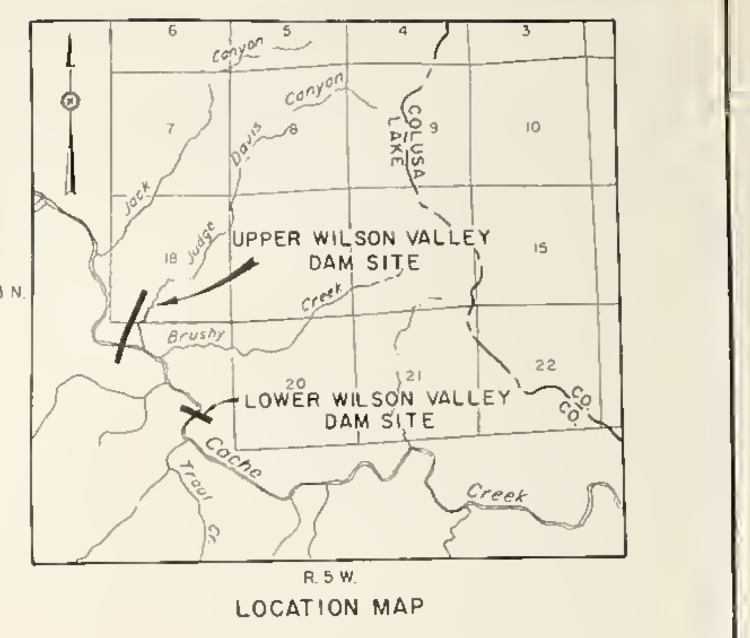
2. The channel section is underlain by an average of 20 feet of unconsolidated sand and gravel river terrace deposits with a maximum depth of 45 feet. A large volume of the terrace deposits would have to be removed for the placement of the desired cutoff to the Tehama formation. Test hole drilling indicates the top of the underlying Tehama formation may be permeable in places and sheared near the right abutment, thus requiring additional excavations.

3. Stripping of 3 to 5 feet on both abutments and spillway will remove the weathered and root zone.

4. Terrace deposits should provide ample quantities of fill material for the proposed type of dam. Select borrow for the core may be obtained from the Tehama formation.

5. Sufficient stream channel deposits for use as gravel drains may be obtained within 2.5 miles of the proposed axis. The Upper Cretaceous sandstone should provide suitable riprap.





LOCATION MAP

LEGEND

QUATERNARY	Qc	COLLUVIUM UNCONSOLIDATED ROCK FRAGMENTS IN SILTY TO CLAYEY MATRIX (LARGELY SLIDE MATERIAL)
	Qal	ALLUVIUM UNCONSOLIDATED SAND, SILT, AND GRAVEL
	Qt	TERRACE OLDER TERRACE GRAVEL
QUATERNARY-TERTIARY	TQc	CACHE FORMATION POORLY CONSOLIDATED SANDS, GRAVELS AND SILTS
UPPER JURASSIC	Jk	KNOXVILLE GROUP WELL CONSOLIDATED SILTSTONES, MUDSTONES AND MINOR SANDSTONES

1F VERTICAL CORE HOLE
9A INCLINED CORE HOLE
5T TRENCH
4F DRIFT
4F-2 SHAFT
SPRING
STRIKE AND DIP
VERTICAL DIP

CONTACT, DEFINITE
CONTACT, INFERRED
FAULT, INFERRED
FAULT, CONCEALED
BULLDOZER ROADS

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION

AREAL GEOLOGY
OF
UPPER AND LOWER WILSON VALLEY
DAM SITES-CACHE CREEK
1958

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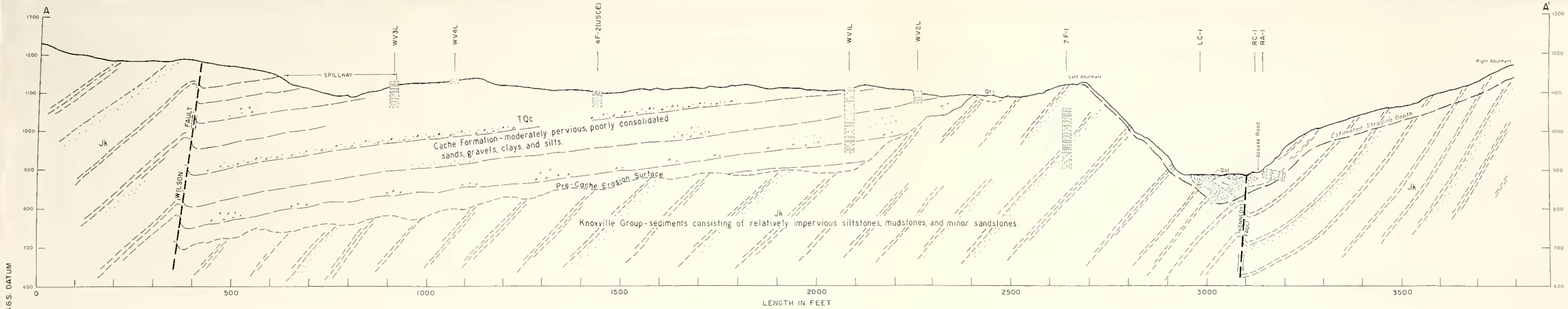
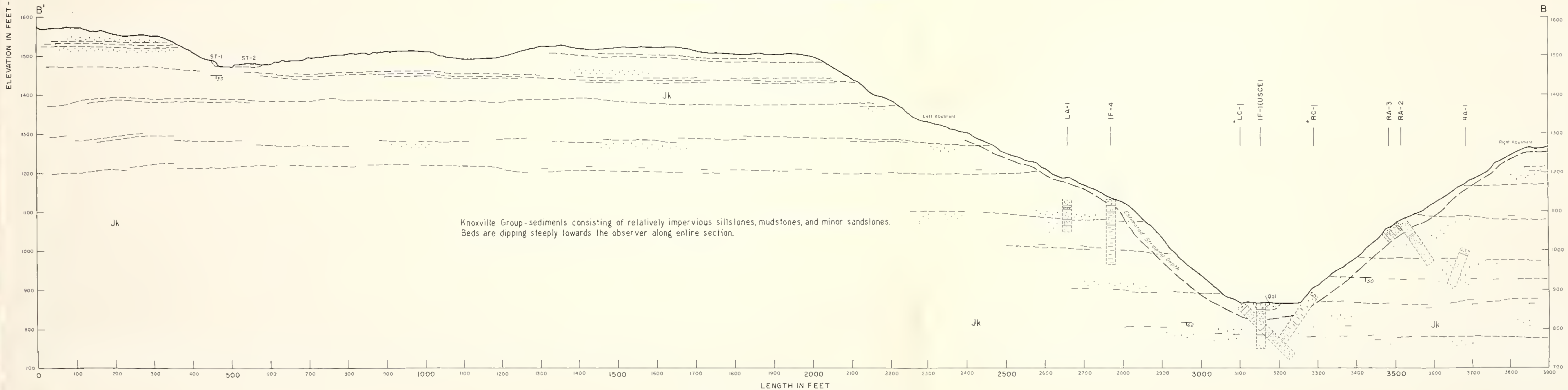
Upp



SECTION A-A', UPPER SITE, WILSON VALLEY



SECTION B-B' LOWER SITE, WILSON VALLEY

LEGEND

- CLAY
- SILTSTONE AND/OR MUDSTONE, POORLY CONSOLIDATED SILT
- SANDSTONE OR POORLY CONSOLIDATED SANDS
- GRAVEL OR POORLY CONSOLIDATED SANDS
- SHEARED MATERIAL

QUATERNARY	Qal	ALLUVIUM
	Qt	TERRACE DEPOSITS
QUATERNARY - TERTIARY	TQc	CACHE FORMATION
UPPER JURASSIC	Jk	KNOXVILLE GROUP

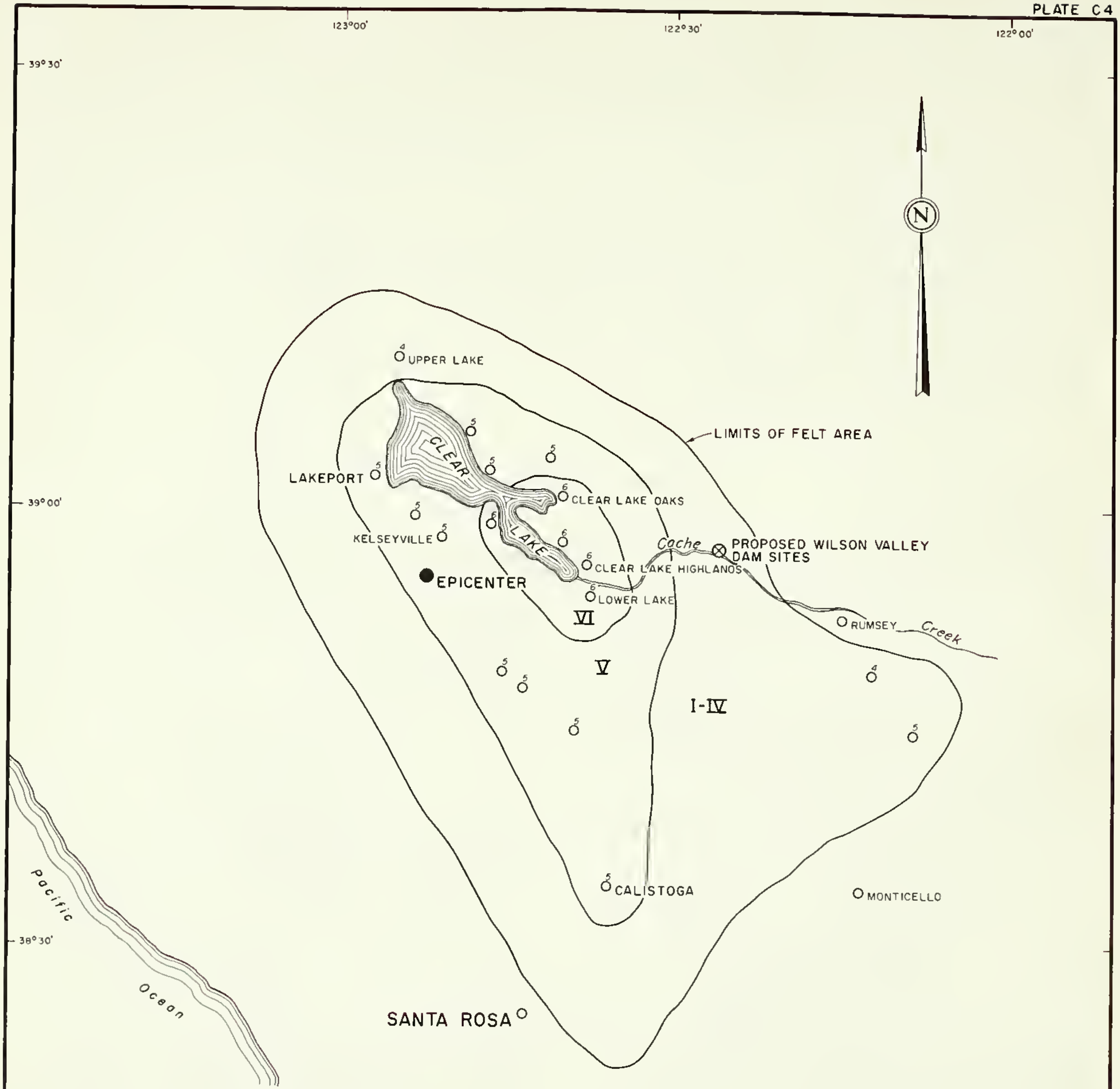
*NOTE: A TRUE GEOMETRIC PROJECTION OF LC-1 AND RC-1 WOULD GIVE A DISTORTED PICTURE OF THE PORTION OF THE CHANNEL COVERED BY THESE HOLES. BOTH HOLES ARE PLOTTED APPROXIMATELY AS THEY WOULD LIE ON A SECTION PARALLEL TO THEIR BEARINGS. (LC-1: BEARING APPROX. S 7° E, DIP 44°; RC: BEARING S 7° W, DIP 46°)

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION

GEOLOGIC SECTIONS
OF UPPER AND LOWER
WILSON VALLEY DAM SITES
1958

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION

POSSIBLE SOURCES OF CONSTRUCTION MATERIALS
WILSON VALLEY DAM SITE
APRIL 1958



NOTE:
Data from U.S Coast and Geodetic Survey Report

LEGEND

V INTENSITY - CORRESPONDING TO ROSSI-FOREL SCALE OF EARTHQUAKE INTENSITY.

$\overset{5}{\circ}$ INTENSITY - LOCAL, CORRESPONDING TO R.-F. SCALE

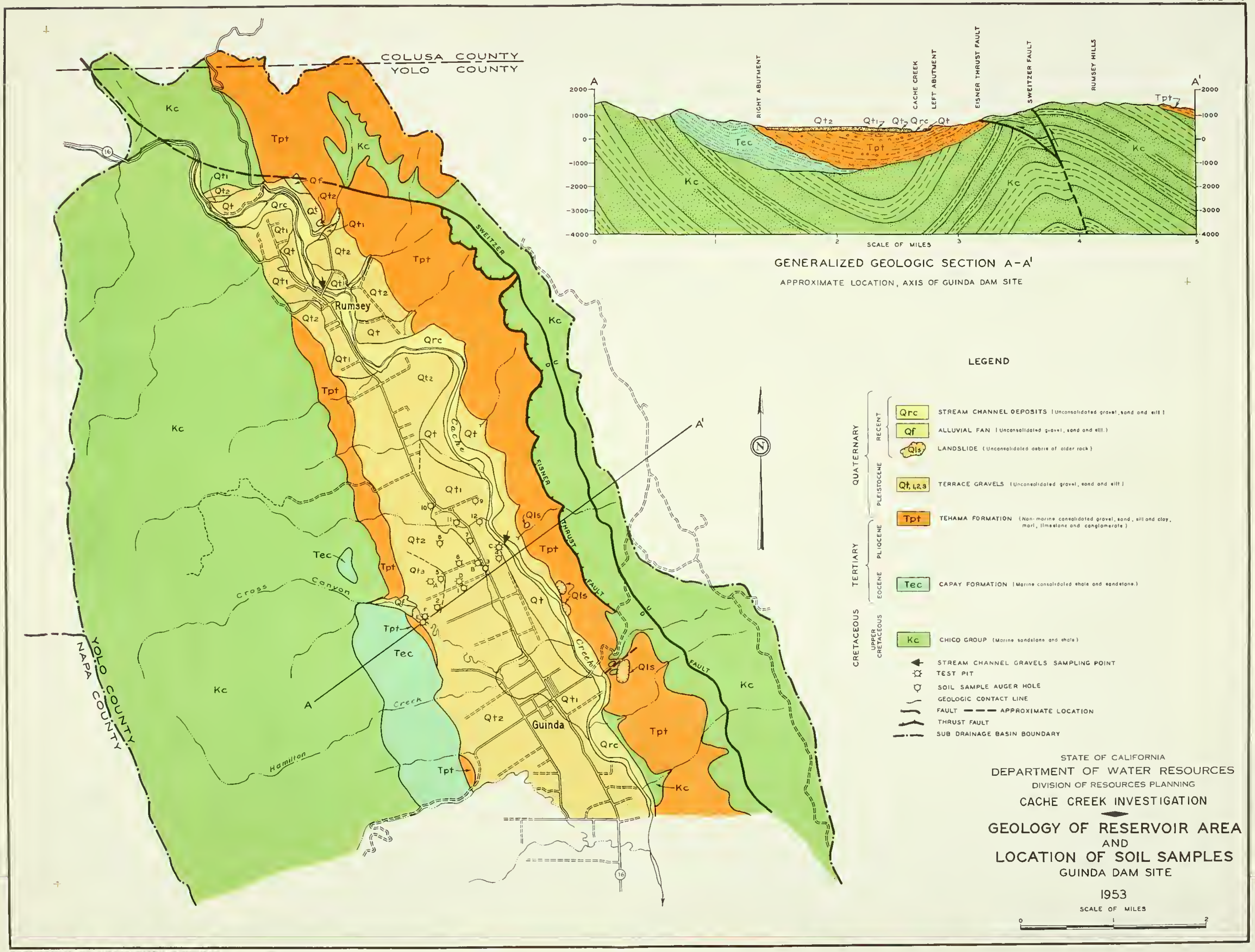
EPICENTER OF EARTHQUAKE WAS
38° 56' NORTH, 122° 52' WEST.
SHOCKS WERE FELT AT 03:50:39 PST.

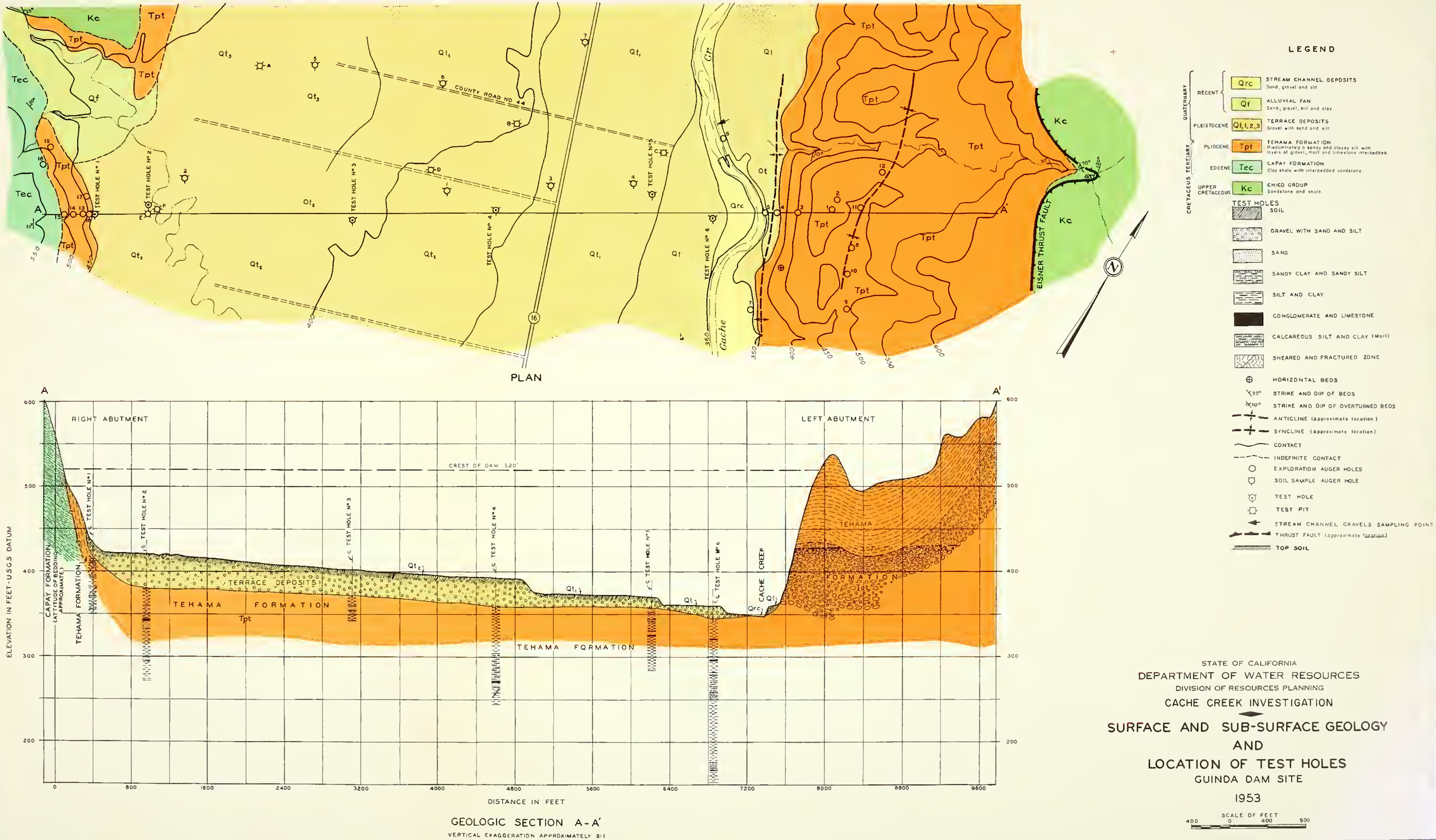
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

CACHE CREEK INVESTIGATION

ISOSEISMAL MAP
FOR
EARTHQUAKE OF MAY 7, 1955

SCALE OF MILES
5 0 5 10 15


COLUSA COUNTY
YOLO COUNTY
YOLO COUNTY
NAPA COUNTY
Rumsey
Guinda
SWEITZER
EISNER THRUST FAULT
FAULT
Cache Creek
Cross Canyon
Hamilton Creek
A
A'
Kc
Tpt
Tec
Qt1
Qt2
Qt3
Qt
Qrc
Qf
Qls
GENERALIZED GEOLOGIC SECTION A-A'
APPROXIMATE LOCATION, AXIS OF GUINDA DAM SITE
RIGHT ABUTMENT
CACHE CREEK
LEFT ABUTMENT
EISNER THRUST FAULT
SWEITZER FAULT
RUMSEY HILLS
SCALE OF MILES
LEGEND
QUATERNARY
RECENT
PLEISTOCENE
TERTIARY
PLIOCENE
EOCENE
CRETACEOUS
UPPER CRETACEOUS
Qrc STREAM CHANNEL DEPOSITS (Unconsolidated gravel, sand and silt)
Qf ALLUVIAL FAN (Unconsolidated gravel, sand and silt)
Qls LANDSLIDE (Unconsolidated debris of older rock)
Qt, 1,2,3 TERRACE GRAVELS (Unconsolidated gravel, sand and silt)
Tpt TEHAMA FORMATION (Non-marine consolidated gravel, sand, silt and clay, marl, limestone and conglomerate)
Tec CAPAY FORMATION (Marine consolidated shale and sandstone)
Kc CHICO GROUP (Marine sandstone and shale)
STREAM CHANNEL GRAVELS SAMPLING POINT
TEST PIT
SOIL SAMPLE AUGER HOLE
GEOLOGIC CONTACT LINE
FAULT — APPROXIMATE LOCATION
THRUST FAULT
SUB DRAINAGE BASIN BOUNDARY
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION
GEOLOGY OF RESERVOIR AREA
AND
LOCATION OF SOIL SAMPLES
GUINDA DAM SITE
1953
SCALE OF MILES



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION

SURFACE AND SUB-SURFACE GEOLOGY AND LOCATION OF TEST HOLES

GUINDA DAM SITE

1953

SCALE OF FEET

APPENDIX D

COURT DECREES

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Gopcevic Decree D-3

Bemmerly Decree D-9

C O P Y

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA,

IN AND FOR THE COUNTY OF MENDOCINO

M. M. GOPCEVIC, and THE HOTALING ESTATE CO., a corporation, and GEORGE T. RUDDICK, Plaintiffs, vs. YOLO WATER AND POWER COMPANY, a corporation, and YOLO WATER AND POWER CORPORATION, a corporation, Defendants, COUNTY OF LAKE and LISLE STUBBS et al, Intervenor	DECREE

Pursuant to the stipulation of all parties herein reduced to writing and filed in open court on the 7th day of October, 1920, agreeing and consenting that the following judgment and decree be entered in the above entitled action, and upon evidence taken; and finding being waived in open court by all parties;

IT IS HEREBY ORDERED ADJUDGED AND DECREED AS FOLLOWS:

That the defendant herein be perpetually enjoined and restrained from excavating or deepening the outlet of Clear Lake, being the Clear Lake mentioned in the pleadings herein, to any depth greater than four feet below the zero mark on the Rumsey gauge at Lakeport, County of Lake, State of California, which said gage is hereinafter more particularly referred to; and from widening straightening or otherwise interfering with said outlet, except

as may be necessary to carry out the provisions of this decree, all of such work to be with the approval first obtained and under the supervision of the State Railroad Commission of California, or the members thereof; and this injunction shall include the said defendants, their and either of their, officers, agents, servants, employees successors and assigns, and each and all officers and agents of either of them, and all persons acting under or in aid of them or either of them.

That the agents, servants, employees, successors and assigns of the said defendants and the said defendants and each of them, and all persons acting under or in aid of them or either of them be perpetually enjoined and restrained from at any time, or in any way raising the level of said lake in excess of 7.56 feet above zero on said Rumsey Gauge, and from at any time or at any way lowering the level of said lake below zero on said Rumsey Gauge; provided, however, that the rise of said Clear Lake, by reason of storm or flood conditions beyond the control of said defendants, or either of them, to a level in excess of 7.56 feet above zero on said Rumsey Gauge, but in no event to a level in excess of 9.00 feet above zero on said Rumsey Gauge, for any period not exceeding ten successive days, shall not be deemed a violation hereof;

The zero mark on said Rumsey Gauge is 20.1 feet below center of large concrete star in northeast corner of court house yard at said Lakeport, and 21.56 feet below iron step at front enterance to Bank of Lake Building at southeast corner of Main Street and Second Street, in said Lakeport;

That said defendants, and each of them, their officers, agents, employees, successors and assigns and all persons acting

under or in aid of them or either of them, be perpetually enjoined and restrained from drawing off from said Clear Lake an amount of water which, inclusive of evaporation and other losses, will at any time reduce the level of said lake below zero on said Rumsey Gauge; and the said defendants, and each of them, their officers, agents, employees, successors and assigns, be perpetually enjoined and commanded to draw off from said lake an amount of water which, inclusive of evaporation and other losses will reduce the level of the lake so that the elevation thereof on the following dates shall not exceed the following percentages of the actual level on April 15th of each year;

May 1, 97%, June 1 89%, July 1, 79%, August 1, 69% and September 1, 58%.

That said defendants and each of them, their officers, agents, employees successors and assigns,be perpetually enjoined and restrained from drawing off from said lake, during the irrigation season an amount of water which, inclusive of evaporation and other losses shall lower the level of said lake more than two feet in any one month;

It is hereby specially adjudged and decreed that notwithstanding the limits of depression of said lake waters hereinabove described the said defendants, and each of them, their agents, employees, successors and assigns, shall not draw off or allow, and they and each of them are enjoined and restrained from drawing off or allowing the waters of said lake to flow out of said lake at any time at such a rate as that, taking into account evaporation and other losses, the water of said lake shall at the lowest level of any year be below zero on said Rumsey Gauge;

It is further adjudged and decreed that the said defendants, or either of them, shall at or about the specific dates last hereinabove mentioned, notify in writing, through the mails or otherwise, the parties hereto and as well such owners or occupants of land on the rim of said lake as shall register their names and addresses with the defendant, Yolo Water and Power Company, at its office in Woodland, Yolo County, California, of the then existing and respective levels of the said lake.

The drawing off of the water of said lake under the conditions aforesaid, shall be by and through the dam and gates mentioned in the pleadings herein, and the administration conduct and operation of said dam and gates shall be responsive to and in full and fair execution of such conditions, and shall at all times be by and under the State Railroad Commission of California, or the members thereof;

If at any time the injunctive provisions of this decree shall be violated, or departed from in matter of substance and all the provisions of this decree are for this purpose taken to be injunctive then and in such events the said defendants and each of them are hereby enjoined and commanded forthwith thereupon, in the manner and to the extent hereinafter provided, or in default thereof it shall be competent to the plaintiffs or any or either of them, or in default of action in the promises by the plaintiffs or any or either of them, it shall be competent to the interveners, or any or either of them, and said parties are accordingly hereby authorized, at the expense of defendants, their successors and assigns to restore and maintain at the "Grigsby Riffle" mentioned in the complaint herein, but above the present mouth of "Seigler Creek" a suitable and substantial structure or barrier, the crest of which shall not exceed one foot above zero on said Rumsey Gauge except as hereinafter provided;

But it is further and specifically decreed that if at any time, for any physical reason, or otherwise, said dam should cease in any substantial sense, to function in respect to the operation of the same as hereinabove referred to, then and in that event the crest of the aforesaid structure or barrier may be increased and maintained to an elevation of two feet above zero on said Rumsey Gauge, said structure and barrier shall exist and be maintained at all times when a dam shall cease to function as provided in this decree for the operation of the same; provided however that the failure of the defendants or either of them to comply substantially with the terms of this decree, due to temporary, unavoidable causes shall not be deemed a violation of this decree;

It is further adjudged that this decree does not adjudicate upon the extent of the several riparian or littoral rights of any of the parties hereto in the said Clear Lake or the land adjacent thereto nor upon any rights or claims of any of said parties to water rights therein, nor in or over such adjacent lands, and that the injunctive relief hereby granted and provided for is not based upon a waiver by any of said parties of any such substantive rights of claims aforementioned but is subject to full reservations on the part of all and each of said parties of all said substantive rights or claims aforesaid;

It is further ordered adjudged and decreed that the said dam and the operation thereof shall at all times be subject to reasonable access and inspection by the parties hereto as well as any person owning land riparian or littoral to said Clear Lake and their duly authorized agents or attorneys; but if any question should arise in respect to the right of any such person or persons to such access and inspection, the same shall be remitted to the state railroad commission of California, or the members thereof for final determination;

That all claims for damages involved in this action or on account of the issuance of the temporary restraining order or preliminary injunction herein are waived and adjudged to be fully settled;

That each party to this action shall pay his own costs.

The signing and filing of this decree shall be deemed to be noticed of the terms thereof and effective as service of any injunctive process consequent thereon.

Done in open Court the 7th day of October, 1920.

A. B. McKenzie

Judge.

CERTIFIED: October 7th, 1920, by the Clerk of said Court to be a full, true and correct copy of the original on file and of record in his office.

ENDORSED: Filed Oct. 7, 1920, HALE PRATHER, Clerk

By W. H. PRATHER, Deputy

RECORDED: October 8th, 1920, in Vol. 60 of Deeds, at page 49. Records of Lake County, California

C. C. McDonald,
Attorney for Plaintiffs,
Woodland, California

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA,

IN AND FOR THE COUNTY OF YOLO.

MARY E. BEMMERLY AND AGNES H. BEMMERLY,

Plaintiffs,

vs.

THE COUNTY OF LAKE, a Political Subdivision of the State of California, E. L. HERRICK, W. E. REICHERT, L. D. KIRKPATRICK, L. L. BURGER AND J. S. KELSAY, as and comprising the Board of Supervisors of the County of Lake, State of California, THE BOARD OF SUPERVISORS OF THE COUNTY OF LAKE, STATE OF CALIFORNIA, E. L. HERRICK, individually and as a member of the Board of Supervisors of the County of Lake, State of California, FRANK W. NOEL, individually, W. E. REICHERT, as a member of the Board of Supervisors of the County of Lake, State of California, W. T. SMITH, individually, L. D. KIRKPATRICK, as a member of the Board of Supervisors of the County of Lake, State of California, L. L. BURGER, individually and as a member of the Board of Supervisors of the County of Lake, State of California, J. S. KELSAY, individually and as a member of the Board of Supervisors of the County of Lake, State of California, FRANK B. JOHNSON, individually and as a County Surveyor of the County of Lake, State of California, FRANK W. CLARK as Director of the Department of Public Works of the State of California, CLEAR LAKE WATER COMPANY, A CORPORATION, J. R. REEVES, JOHN DOE DREDGING COMPANY, RICHARD ROE DREDGING CO., FIRST DOE, SECOND ROE AND THIRD ROE,

Defendants.

No. 8812

J U D G M E N T

This cause having been regularly called and tried by the Court, and the findings of fact and conclusions of law, and the decision thereon in writing, having been rendered, wherein judgment was ordered in favor of the plaintiffs and against the defendants hereinafter named as prayed for in the complaint and for costs,

IT IS, BY THE COURT, ORDERED, ADJUDGED AND DECREED that the defendants, The County of Lake, a Political Subdivision of the State of California, E. L. Herrick, W. E. Reichert, L. D. Kirkpatrick, L. L. Burger and J. S. Kelsay, as and comprising the Board of Supervisors of the County of Lake, State of California, the Board of Supervisors of the County of Lake, State of California, E. L. Herrick, individually and as a member of the Board of Supervisors of the County of Lake, State of California, Frank W. Noel, individually, W. E. Reichert as a member of the Board of Supervisors of the County of Lake, State of California, W. T. Smith, individually, L. D. Kirkpatrick as a member of the Board of Supervisors of the County of Lake, State of California, L. L. Burger, individually and as a member of the Board of Supervisors of the County of Lake, State of California, J. S. Kelsay, Individually and as a member of the Board of Supervisors of the County of Lake, State of California, Frank B. Johnson, individually and as County Surveyor of the County of Lake, State of California, Frank W. Clark, as Director of the Department of Public Works of the State of California, and Clear Lake Water Company, a corporation, and each and all of them, and their, and each of their attorneys, agents, servants and employees and any and all persons acting under said defendants, or any of them, be, and they and each and all of them are hereby forever enjoined and restrained from in any manner widening, deepening or enlarging the arm or slough which constitutes the outlet of the waters of and from Clear Lake into Cache Creek and from in any manner changing the said outlet so as to increase the flow of waters of and from Clear Lake into Cache Creek. The Clear Lake herein referred to is the Clear Lake described in the plaintiffs' complaint and which is located in the County of Lake, State of California.

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that plaintiffs have judgment for their costs taxed at Dollars ($).

Judgment rendered December 18th, 1940.

/s/ Dal M. Lemmon
Judge of the Superior Court

APPENDIX E

SUPPLEMENTAL AGREEMENT BETWEEN
STATE WATER RESOURCES BOARD, COUNTY
OF YOLO, AND DEPARTMENT OF PUBLIC WORKS,
DATED SEPTEMBER 26, 1955

SUPPLEMENTAL AGREEMENT BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTY OF YOLO, AND THE DEPARTMENT OF PUBLIC WORKS

THIS SUPPLEMENTAL AGREEMENT, executed in quintuplicate, entered into as of the 26th day of September, 1955, by and between the State Water Resources Board, hereinafter referred to as the "Board", the County of Yolo, hereinafter referred to as the "County", and the Department of Public Works, State of California, acting through the agency of the State Engineer, hereinafter referred to as the "State Engineer":

WITNESSETH

WHEREAS, an agreement entered into as of the 7th day of May, 1954, by and between the parties hereto, provided for (1) review of reports of prior investigations of the water resources of Cache Creek watershed and potential service areas in Yolo County, (2) investigations and studies to determine present water utilization and potential service areas for Cache Creek water in Yolo County, the water resources thereof, ultimate irrigable land, water requirements, preliminary plans and estimates of costs for control, development and utilization of said water resources, and preparation of a report thereon; and

WHEREAS, by said agreement the Board authorized the State Engineer to conduct said investigation and prepare said report; and

WHEREAS, the expense of performing the aforesaid work was estimated to be approximately $24,000 of which sum one half was contributed by the County and the remaining one half by the State of California; and

WHEREAS, work on the aforesaid review and investigation was initiated and an interim report thereon, dated March, 1955, was prepared by the State Engineer, transmitted to the Board, and was approved and transmitted by the Board to the California Legislature; and

WHEREAS, Section 12663 was added to the Water Code by Chapter 1950, Statutes of 1955, which section adopts the plan of improvement for flood control and water conservation on Cache Creek, including Clear Lake, in Yolo and Lake Counties, and authorizes the same generally in accordance with the plans and recommendations relating thereto contained in the aforesaid interim report, and which section further provides that no funds shall be expended on planning or constructing a dam at the Guinda site below Rumsey on Cache Creek until the Wilson Valley area has been completely investigated and studied, and determined by the Board not to have comparable engineering and economic feasibility as compared to the Guinda site as recommended in said report; and

WHEREAS, it is estimated that approximately $45,000 will be required to fully perform the additional work called for by the aforesaid legislation, and no funds are presently available for such purpose on behalf of the State of California and cannot be made available prior to the next session of the Legislature; and

WHEREAS, the County desires prompt performance and completion of the work called for by the aforesaid legislation in order that the continuing water shortage in the County may be alleviated at the earliest possible time;

NOW, THEREFORE, in consideration of the premises, it is mutually agreed by the Board, the County, and the State Engineer as follows:

ARTICLE I--WORK TO BE PERFORMED

The work to be performed under this agreement, to the extent funds are made available therefor, shall consist of a complete investigation and study of the Wilson Valley area in accordance with the requirements of Chapter 1950, Statutes of 1955, and will include hydrologic studies of runoff and yields of reservoirs coordinated with the operation of Clear Lake, studies of flood control benefits, geologic studies, collection and laboratory testing of construction and foundation materials, exploration of foundations by drilling, estimates of costs of rights-of-way and highway relocation, preparation of designs and cost estimates of dams and reservoirs at the Wilson Valley sites, economic and engineering comparison with a dam and reservoir at the Guinda site on Cache Creek, and preparation of a report on the investigation.

The Board by this supplemental agreement authorizes and directs the State Engineer to cooperate by conducting said investigation and preparing said report and by otherwise advising and assisting in formulating solutions to the water problems in Yolo County.

During the progress of said investigation, all maps, plans, information, data, and records pertaining thereto which are in the possession of any party hereto, shall be made fully available to any other party hereto for the due and proper accomplishments of the objectives hereof.

The work to be done under this agreement shall be diligently prosecuted with the objective of completing the investigation and report by April, 1957, or as nearly thereafter as possible.

ARTICLE II--FUNDS

On execution of this agreement, the County shall transmit the sum of Twenty-Two Thousand Five Hundred Dollars ($22,500) to the State Engineer for deposit, subject to the approval of the Director of Finance, into the Water Resources Revolving Fund in the State Treasury, for expenditure by the State Engineer in performance of the work provided for in this agreement. Immediately upon an appropriation of funds to the Board by the Legislature for such purpose, the Board shall request the Director of Finance to approve the transfer of the sum of Twenty-Two Thousand Five Hundred Dollars ($22,500) from funds appropriated to the Board as aforesaid to the said Water Resources Revolving Fund for expenditure by the State Engineer in performance of work provided for in this agreement, and immediately upon such transfer and deposit in said Water Resources Revolving Fund, the money shall be available for expenditure as aforesaid.

It is understood by and between the parties hereto that the sum of Forty-Five Thousand Dollars ($45,000) is adequate to perform the above specified work.

It is further understood by and between the parties hereto that this supplemental agreement shall take effect as of the date of its execution and that commencement of the work provided herein shall be authorized upon deposit into the Water Resources Revolving Fund in the State Treasury of the money transmitted by the County to the State Engineer for that purpose, notwithstanding that completion of the work will be contingent upon the appropriation of funds by the Legislature to the Board as hereinbefore set forth. It is contemplated that such appropriation will be made, but neither the Board nor the State Engineer assumes any liability for completion of the work or for any portion of the funds already expended in the event said appropriation is not made.

The Board and the State Engineer shall under no circumstances be obligated to expend for or on account of the work provided for hereunder any amount in excess of the funds made available for such work.

Upon completion and final payment for the work provided for in this supplemental agreement, in the event the Legislature appropriates funds to the Board to be expended for performance of such work, the State Engineer shall furnish to the Board and to the County a statement of all expenditures made under this agreement, and one half of the total of all said expenditures shall be deducted from the sum advanced from funds appropriated to the Board and one half of the total amount of all of said expenditures shall be deducted from the sum advanced by the County and any balance which may remain shall be returned to the Board and to the County in equal amounts.

In the event the Legislature fails to appropriate funds to the Board for expenditure in performance of the work provided for in this supplemental agreement, the State Engineer shall report on the work accomplished and shall furnish to the Board and to the County a statement of all expenditures made hereunder and the total amount of such expenditures shall be charged to the sum advanced by the County.

Not withstanding anything herein contained to the contrary, this agreement may be terminated and its provisions may be altered, changed, or amended, by mutual consent of the parties hereto.

IN WITNESS WHEREOF, the parties hereunto executed this supplemental agreement as of the date first herein written.

Approved as to Form and Procedure

/s/ Anthony B. Avilla
District Attorney
County of Yolo

Approved as to Form and Procedure

/s/ Henry Holsinger
Attorney for Division of Water Resources MCN

APPROVED AS TO FUNDS

Comptroller

:S.H.Y.	:J.F.M.	:F.W.L.	:
:Form	:Budget	:Value	:Descript.

DEPARTMENT OF FINANCE
APPROVED
Oct 7 1955
JOHN M. PEIRCE, Director
By /s/ Louis J. Heinzer
Administrative Adviser

COUNTY OF YOLO

By /s/ J. W. McDermott
Chairman, Board of Supervisors

S
E
A
L

C. L. Hiddleson
Clerk, Board of Supervisors
By /s/ R. J. Christison, Deputy

STATE WATER RESOURCES BOARD

By /s/ Clair A. Hill
Clair A. Hill, Chairman

S
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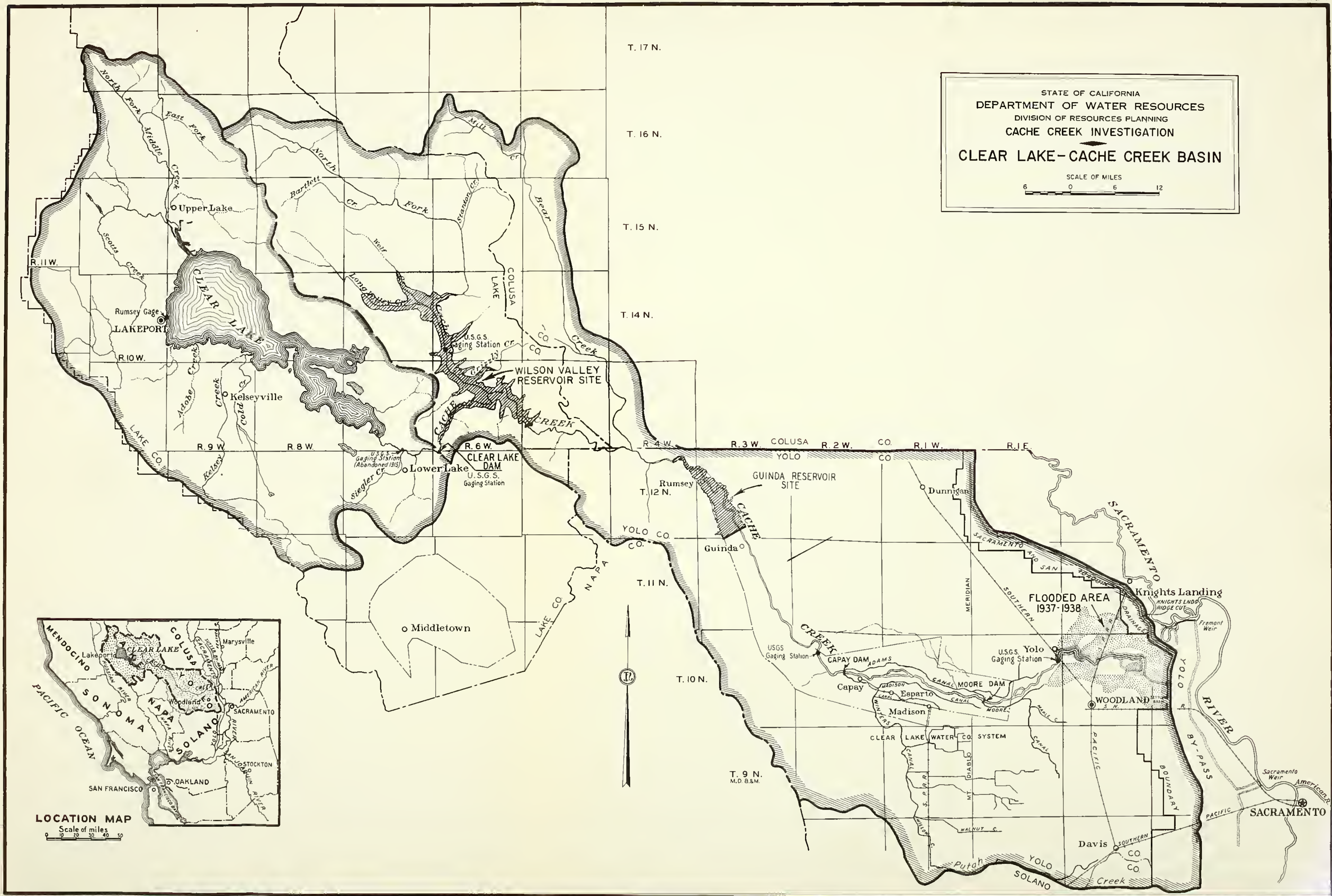
L

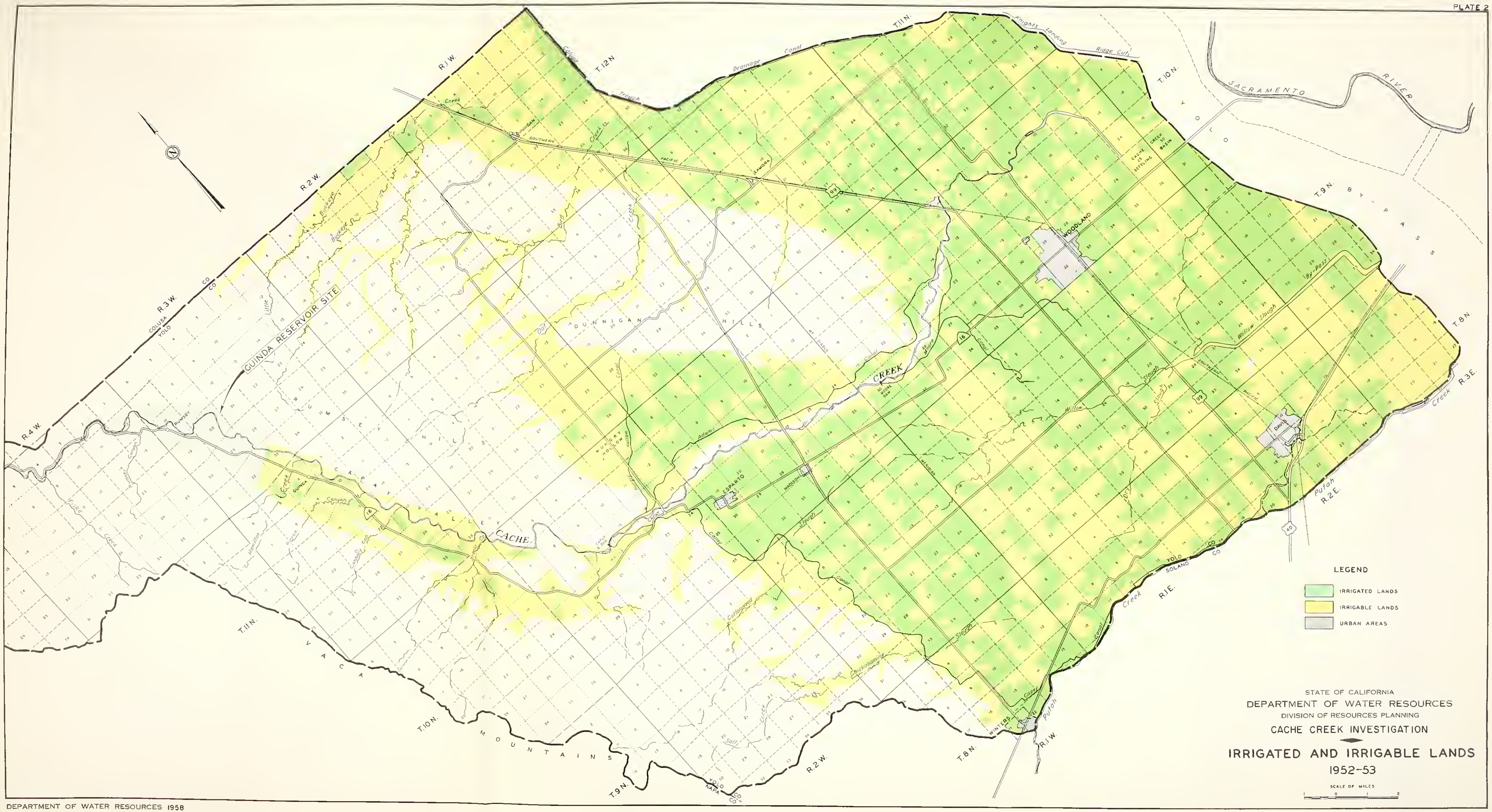
DEPARTMENT OF PUBLIC WORKS
FRANK B. DURKEE, DIRECTOR

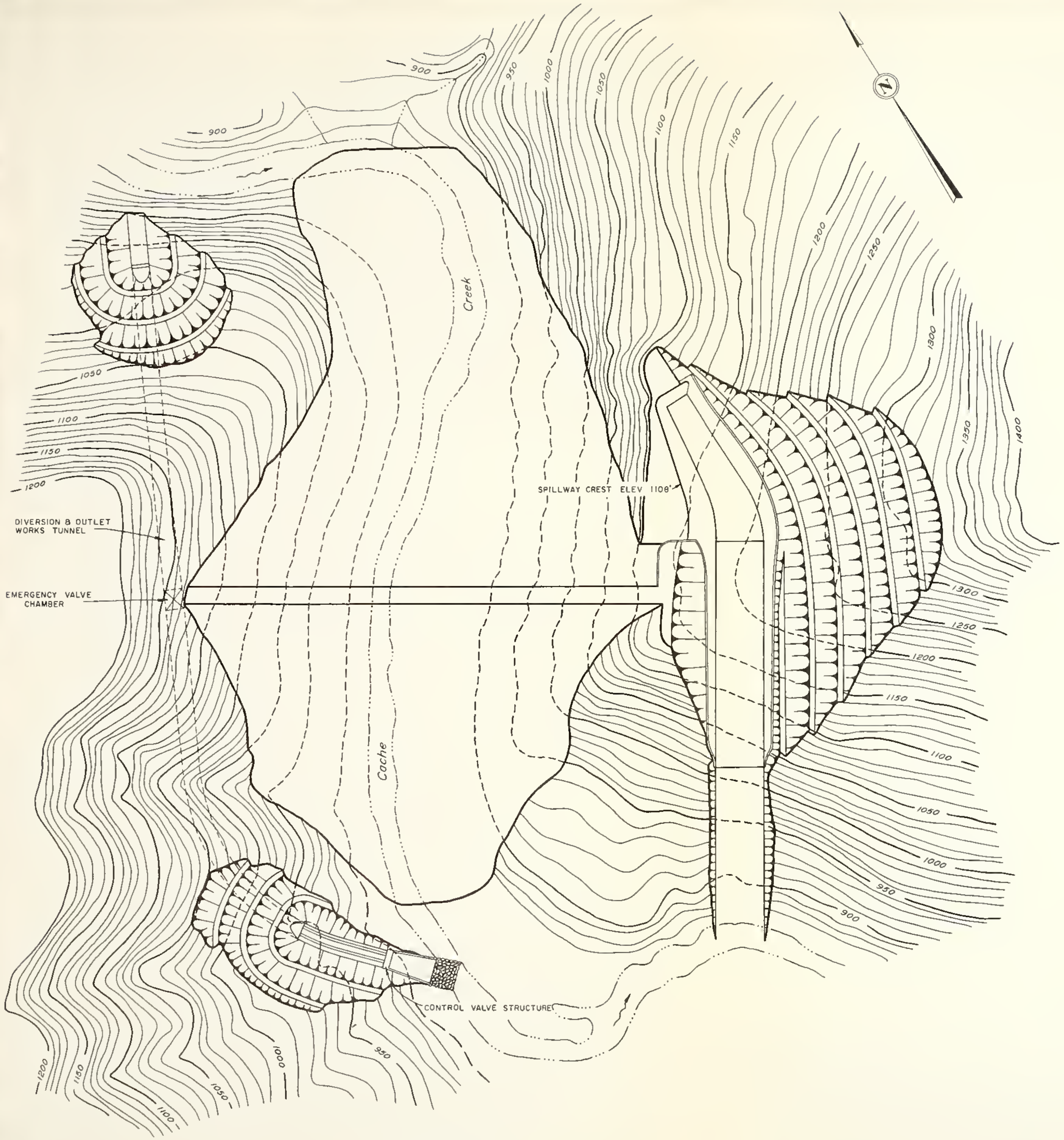
By /s/ C. M. Gilliss
C. M. Gilliss
Deputy Director of Public Works

/s/ A. D. Edmonston
A. D. Edmonston, State Engineer

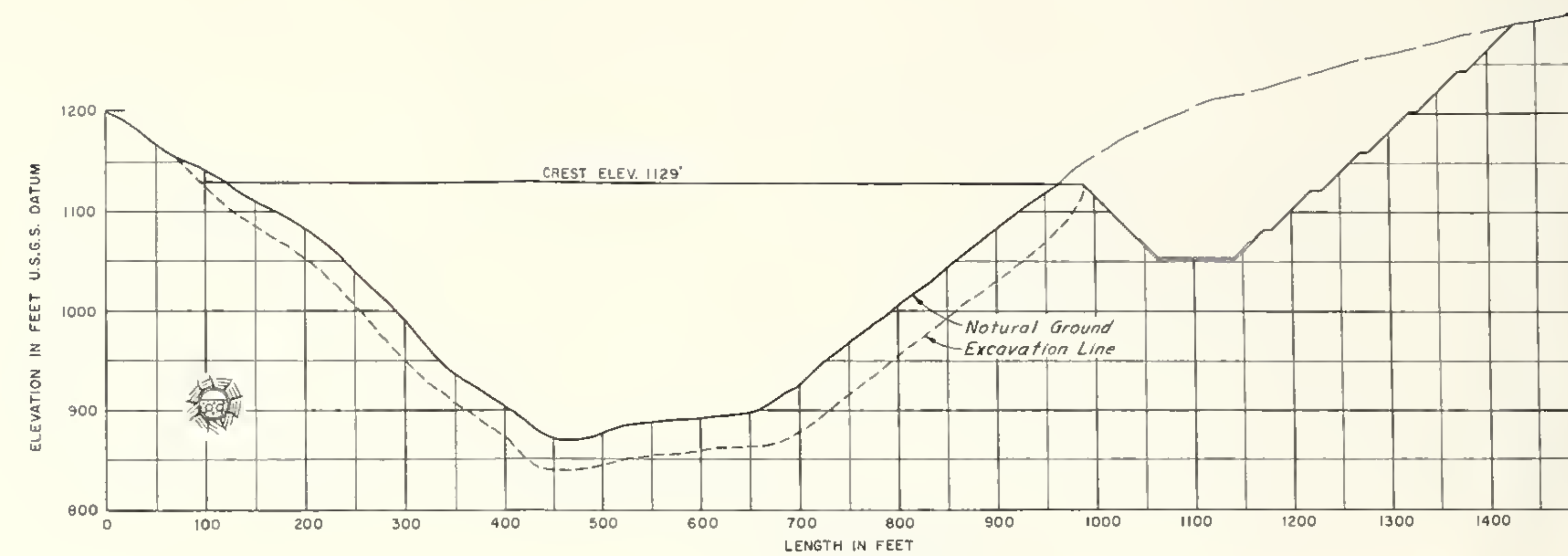


DEPARTMENT OF WATER RESOURCES 1958

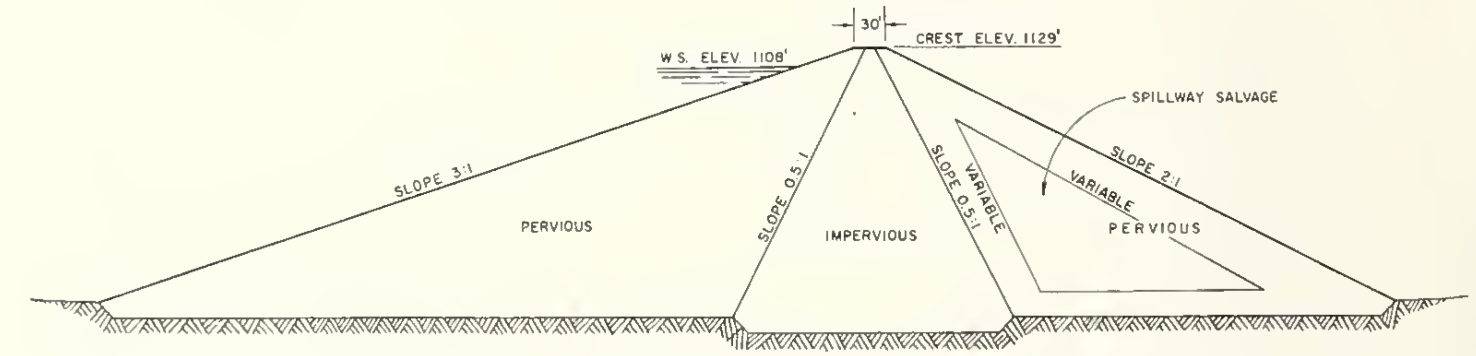

LEGEND
IRRIGATED LANDS
IRRIGABLE LANDS
URBAN AREAS
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION
IRRIGATED AND IRRIGABLE LANDS
1952–53
SCALE OF MILES
GUINDA RESERVOIR SITE
DUNNIGAN HILLS
CACHE CREEK
SACRAMENTO RIVER
YOLO BY-PASS
WOODLAND
DAVIS
ESPARTO
WINTERS
RUMSEY
GUINDA
DUNNIGAN
ZAMORA
MADISON
CAPAY VALLEY
VACA MOUNTAINS
Putah Creek
Willow Slough
Knights Landing Ridge Cut
Drainage Canal
SOUTHERN PACIFIC
R.4 W.
R.3 W.
R.2 W.
R.1 W.
R.1 E.
R.2 E.
R.3 E.
T.12 N.
T.11 N.
T.10 N.
T.9 N.
T.8 N.
COLUSA CO
YOLO CO
SOLANO CO
NAPA CO



GENERAL PLAN
SCALE IN FEET
0 100 200



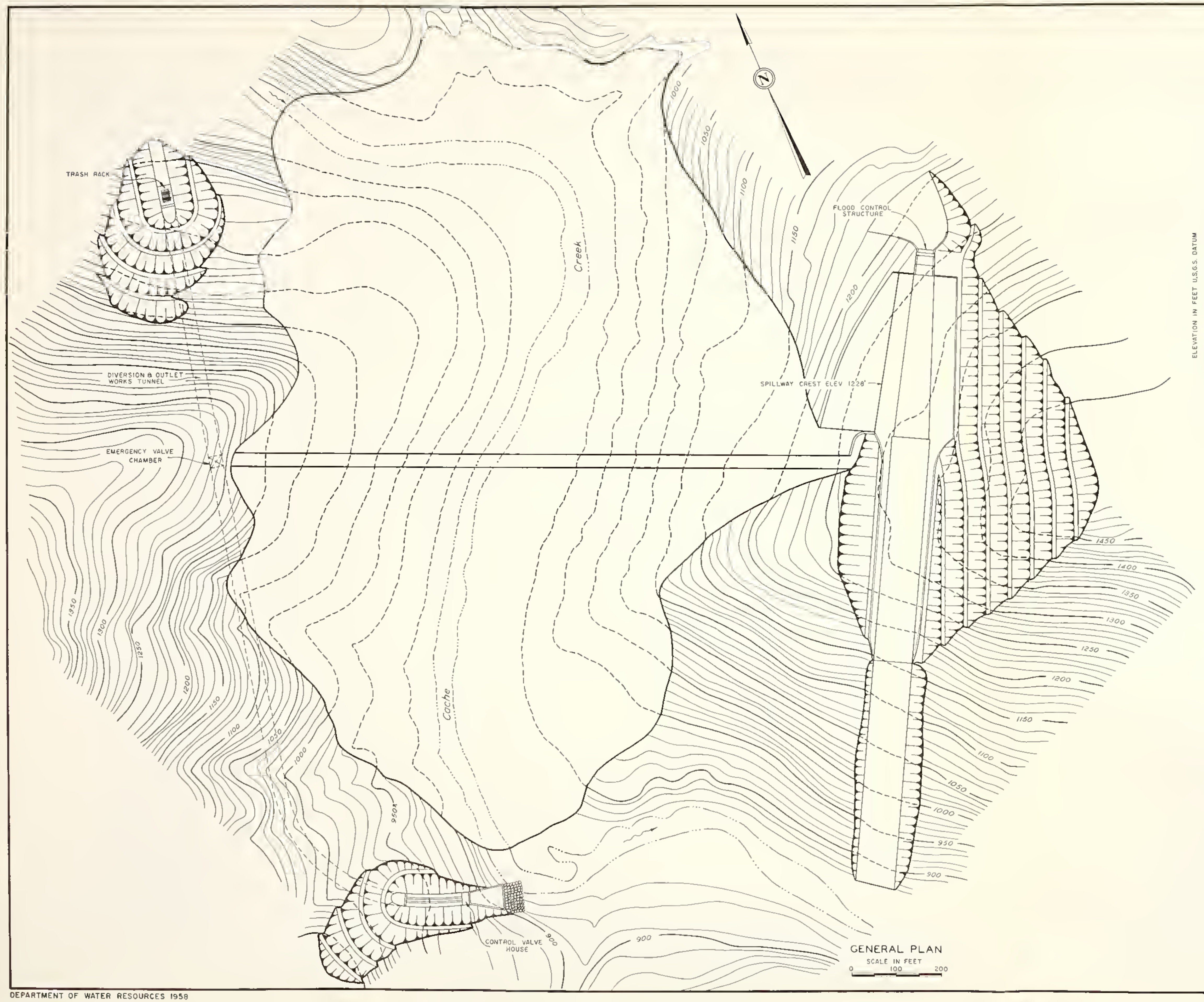
PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF DAM
SCALE IN FEET
0 100 200

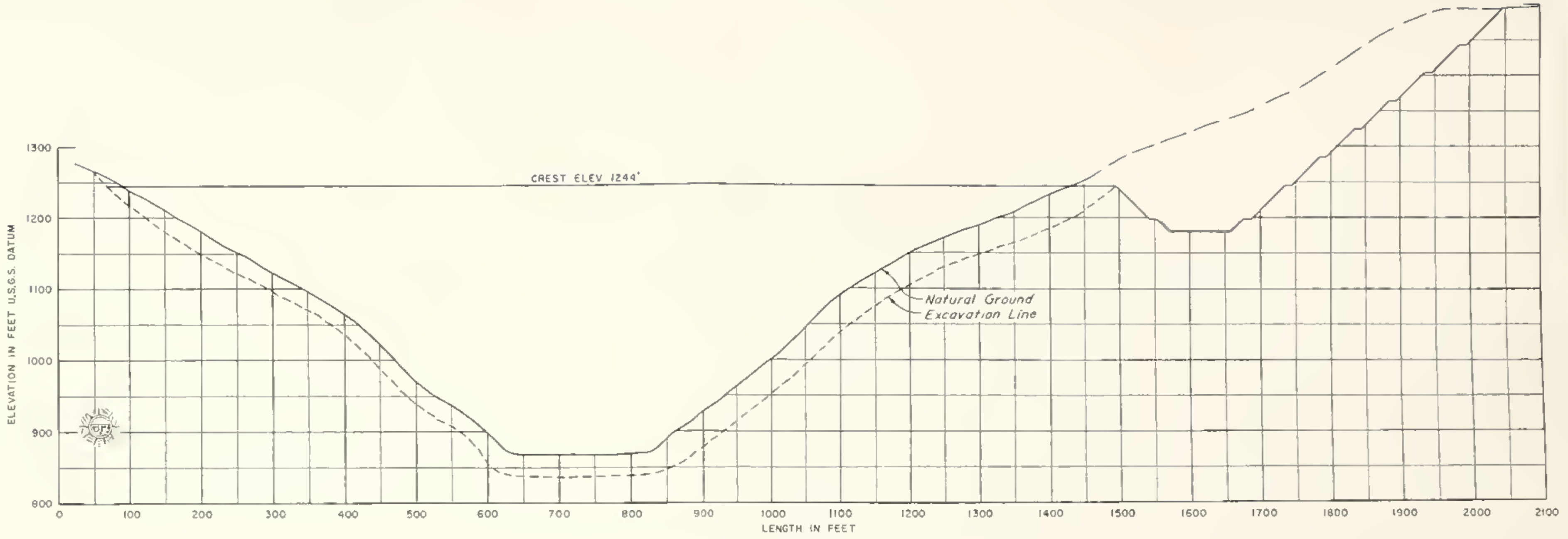
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION

WILSON VALLEY DAM ON CACHE CREEK
RESERVOIR STORAGE CAPACITY OF 300,000 ACRE-FEET



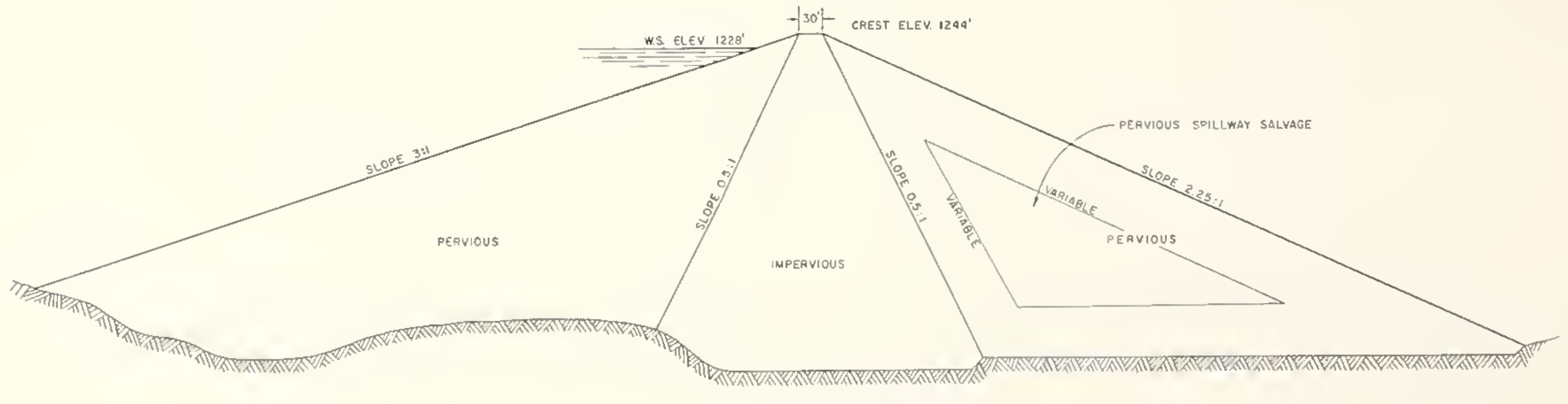
GENERAL PLAN

SCALE IN FEET
0 100 200



PROFILE OF DAM

LOOKING UPSTREAM



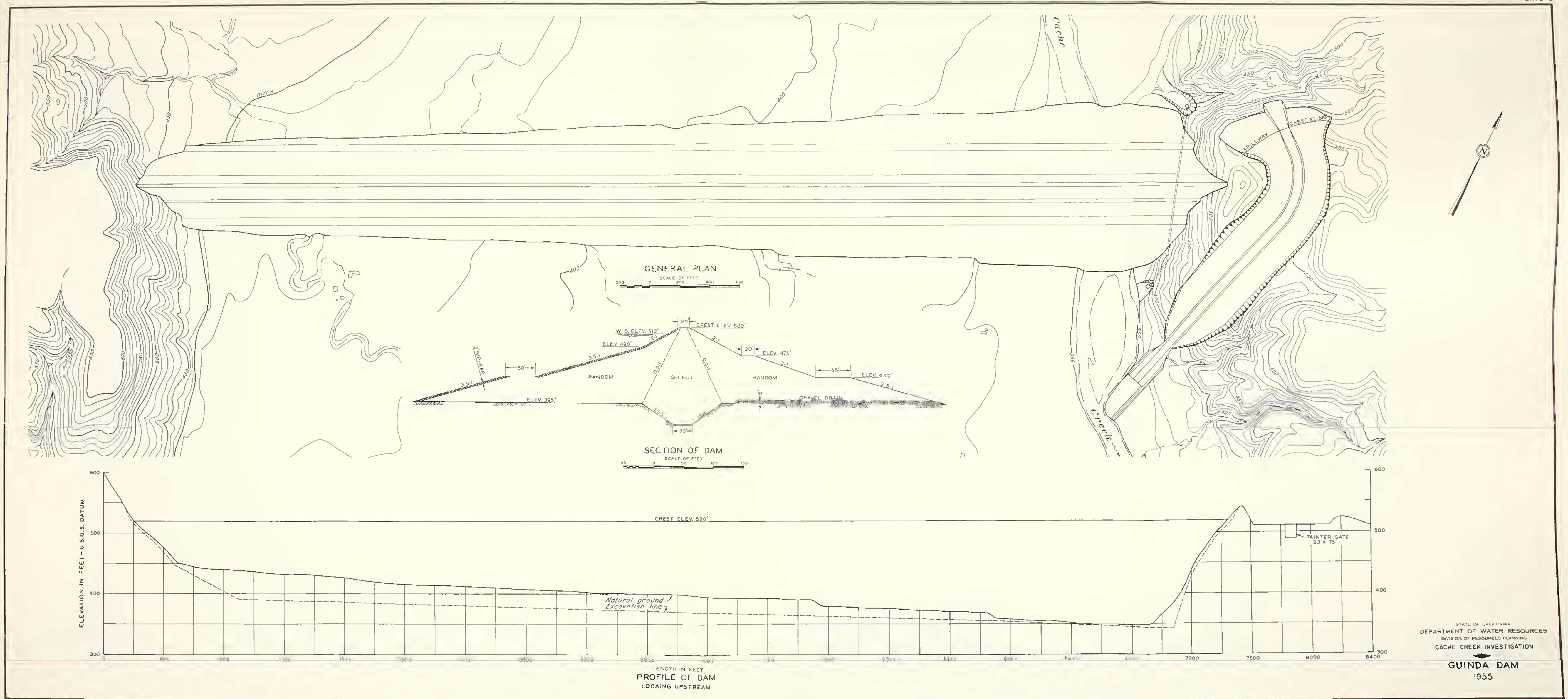
SECTION OF DAM

SCALE IN FEET
0 100 200

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION

WILSON VALLEY DAM ON CACHE CREEK

RESERVOIR STORAGE CAPACITY OF 1,000,000 ACRE-FEET



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
CACHE CREEK INVESTIGATION

GUINDA DAM
1955

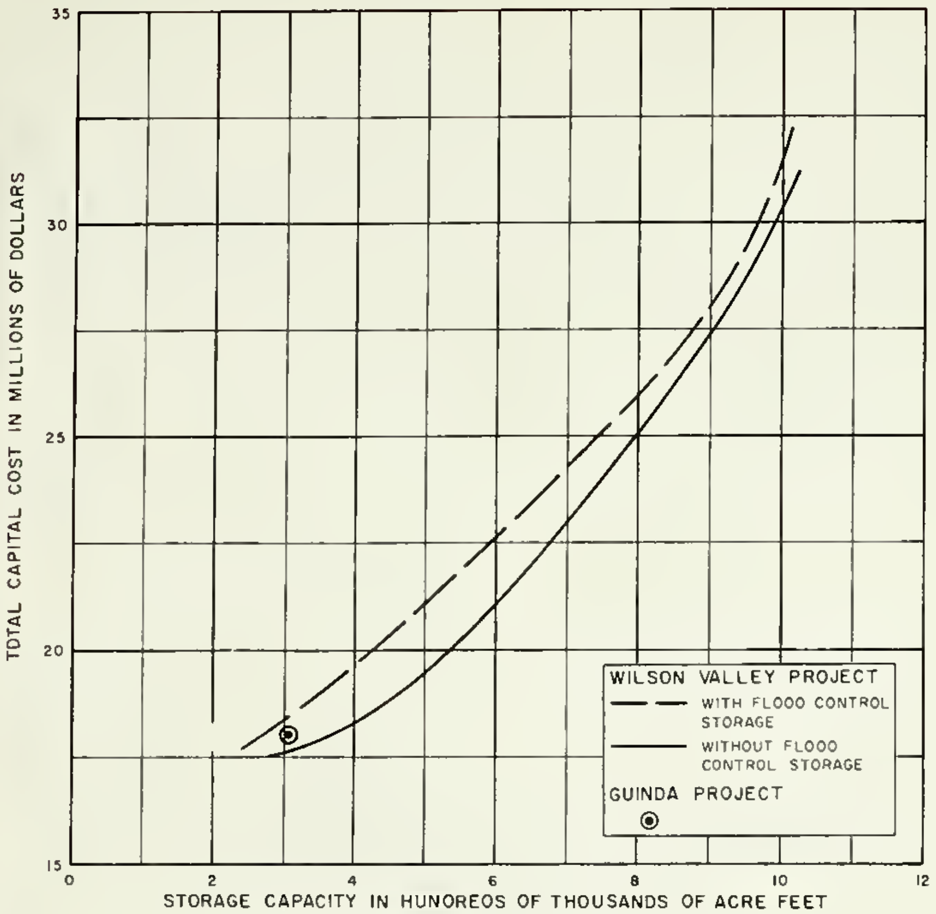


Fig. 1. TOTAL CAPITAL COST

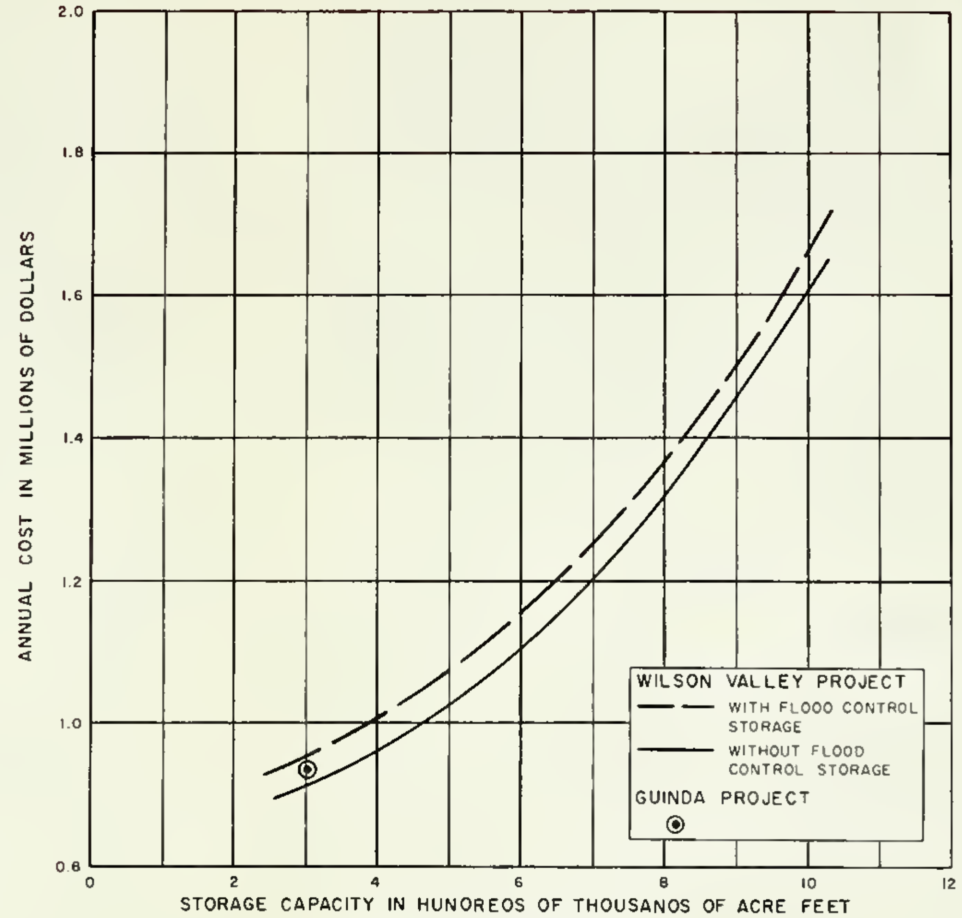


Fig. 2. ANNUAL COST

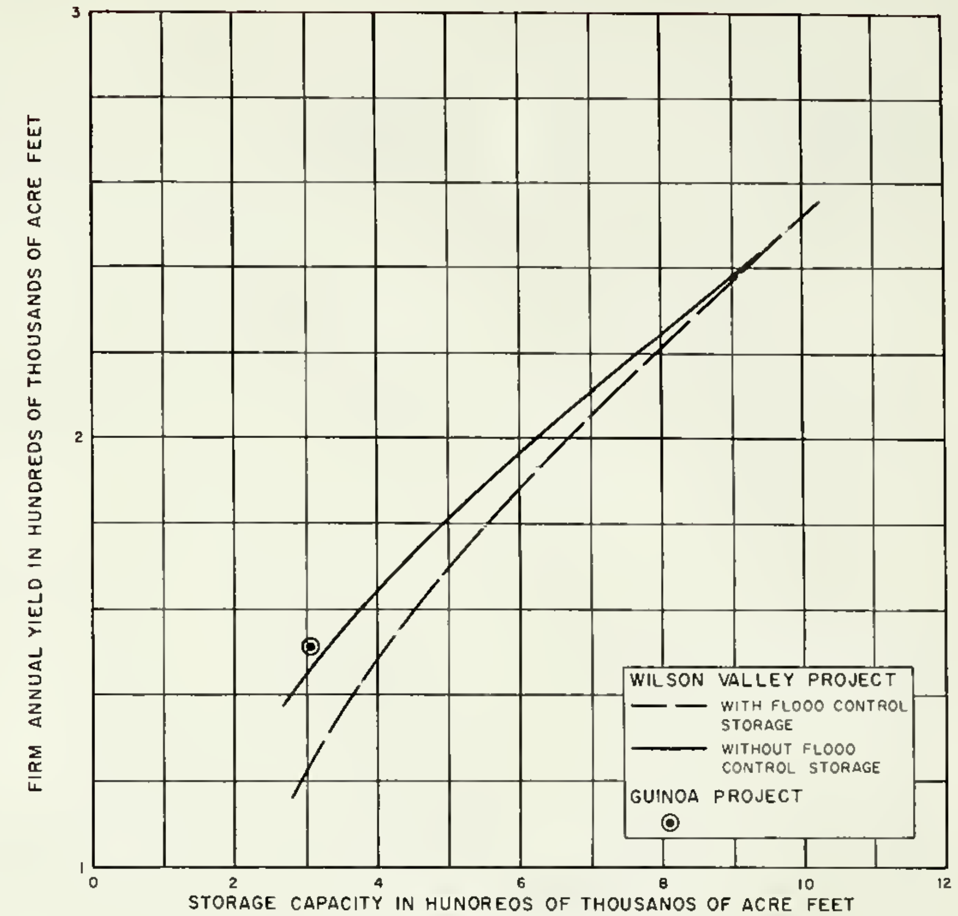


Fig. 3. FIRM ANNUAL YIELD

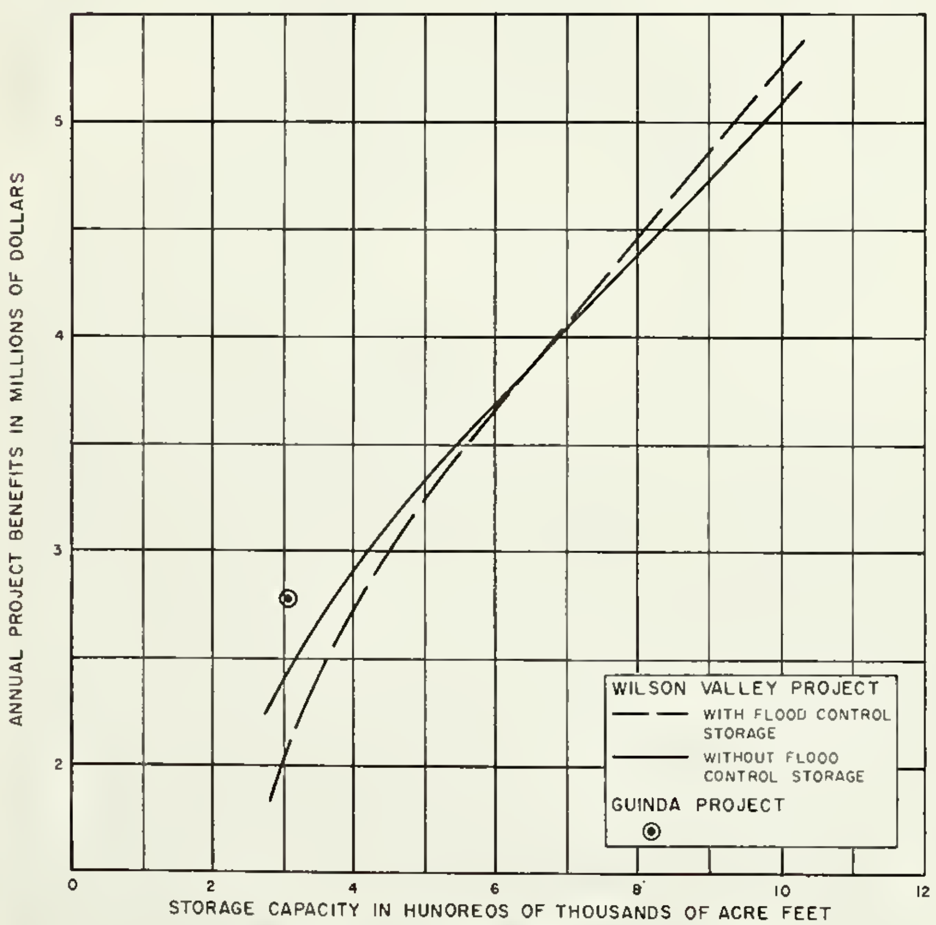


Fig. 4. ANNUAL PROJECT BENEFITS

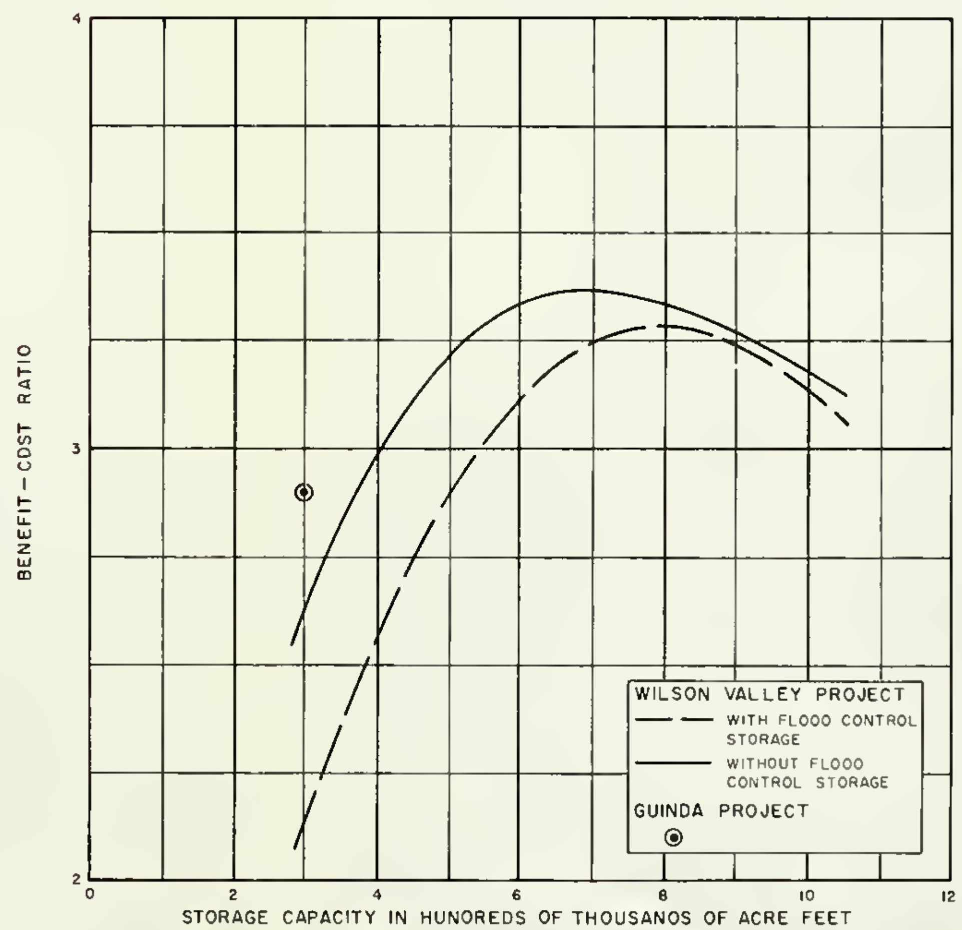


Fig. 5. BENEFIT-COST RATIO

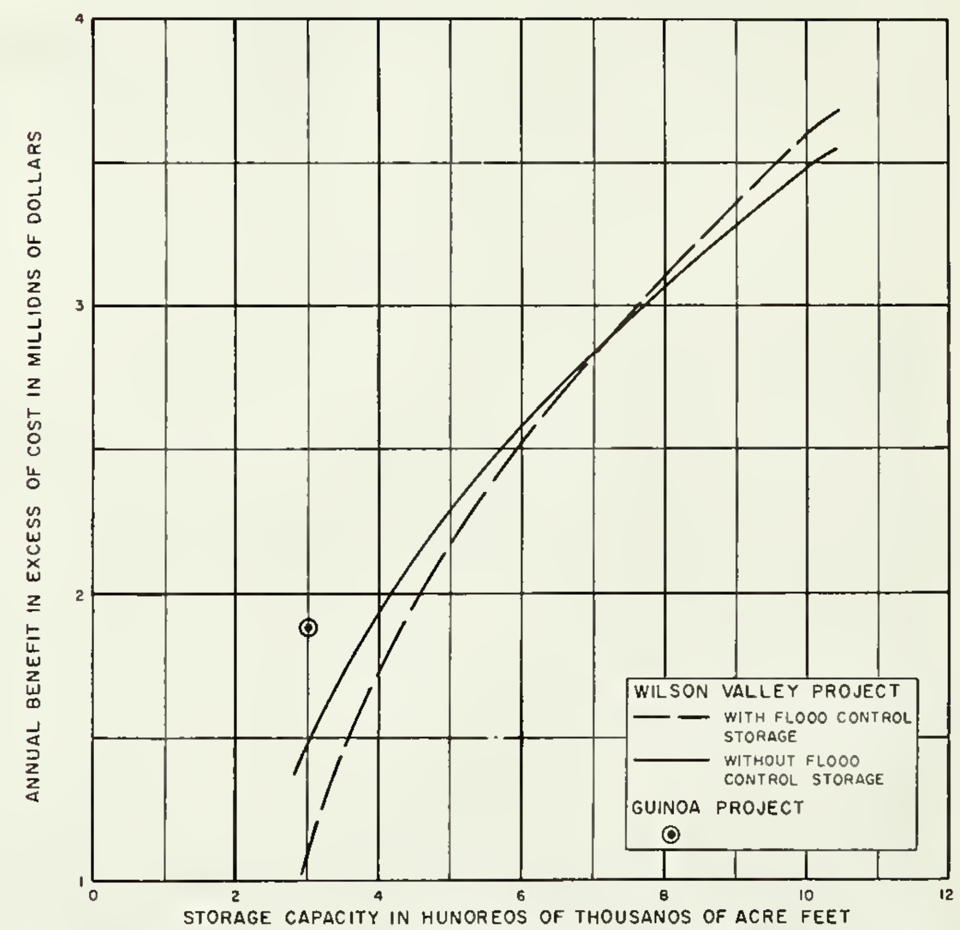


Fig. 6. ANNUAL BENEFITS IN EXCESS OF ANNUAL COSTS

COMPARATIVE DATA FOR WILSON VALLEY AND GUINDA PROJECTS

APRIL 1958